THE GEOGRAPHICAL REVIEW

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PUBLISHED BY

THE AMERICAN GEOGRAPHICAL SOCIETY
OF NEW YORK

OCTOBER

1920

THE
GEOGRAPHICAL REVIEW

VOL. X OCTOBER, 1920 NO. 4

MADAGASCAR

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Madagascar, situated to the southeast of Africa, appears at first glance to form a dependency of that continent, whence the name Great African Island by which it is not infrequently known. But the designation conveys an erroneous idea, for this new colony of France is a little continent in itself, isolated from the rest of the world and preserving in its isolation relics of a vanished geological age. Its soil, animals, plants, peoples all have a distinguishing characteristic: they are Malagasy. In a word, Madagascar is biologically an entity—a whole on which a complete monograph might be written without reference to neighboring regions save by way of comparison. And this constitutes not the least of the charms that make the island so alluring a subject of study.

THREE MAJOR NATURAL REGIONS

Madagascar, covering an area of 228,000 square miles, is somewhat larger than France. The island exhibits a very diversified relief. The eastern and central portions comprise granitic terrains, the western coastal region is predominantly calcareous. The culminating elevations of the island, nearly 3,000 meters (over 9,000 feet), are found in the extinct volcanoes of the north and center. The distance between the most northerly point (Cape Amber, latitude 12° S.) and the southern extremity (Cape St. Mary) being approximately 1,000 miles, the island belongs as regards climate in part to the tropical, in part to the temperate zone. Hence it is not surprising to find in Madagascar a variety of regions quite distinct in regard to the flora and fauna and in the mode of life of their inhabitants.

Three major natural regions may be recognized: the Central Massif, or Central Plateau; the Eastern Coast Chain, which descends more or less abruptly to the Indian Ocean; and the Plains region of the south and west, sloping gently to the shores of the Mozambique Channel.

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The Central Plateau

The Central Plateau, as it is commonly called, occupies about one-quarter of the island and includes the regions of Imerina and Betsileo in their entirety. It is a chaotic mountain mass having a mean altitude of 1,200 meters. The recent eruptive material excepted, it is formed of primitive rocks, in part exposed, in part covered with the product of decomposition—the red argillaceous earth known as laterite. Because of its deficiency in plant food the red earth forms a poor soil from the agronomic point of view. Furthermore, the region is very arid, and cultivation succeeds only in the depressions naturally humid or irrigated from the watercourses.

But on the other hand the climate is good. The temperature is agreeable to Europeans.[1] Malarial sickness is rare and where it exists is seldom of a grave nature. This is the most populous region. The immigrant Malays, progenitors of the Hova, shunning the unhealthful districts of the eastern coast, sought refuge here. Here are the largest towns, such centers as Antananarivo and Fianarantsoa. Here Europeans can both live and work.

The Eastern Coast Chain

The Central Plateau of Madagascar extends over a little less than half the breadth of the island. The long coastal chain which separates it from the Indian Ocean occupies only one-fifth, having a width of some 80 kilometers. This chain, the second of our regions, has a north-northeast to south-southwest orientation closely bordering the shore from which it rises by successive steps to an altitude of 1,000 to 1,500 meters. A sandy zone more or less broad gives place to hilly ground, 20 to 50 meters high and characterized by a special type of vegetation which includes the traveler's-tree (*Ravenala madagascariensis*); the vacoa (*Pandanus utilis*); and the raffia (*Raphia ruffia*), the palm whose graceful fronds furnish fiber for rope weaving.

Above these low hills commence the mountains proper. The climate is warm, moist, equable, and favorable to the growth of a luxuriant vegetation.[2] Patches of virgin forest still remain scattered over the entire eastern slope, though much destruction has been wrought by the native cultivators who have burned over extensive areas. Just under the summit, however, there stretches along the entire length of the island a continuous band of magnificent forest abounding in valuable plants, in tree ferns and orchids.

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[1] The average annual temperature of Antananarivo (1400 m.) is 62° F., the extreme months being February, 67° F., and July, 55° F. (Julius Hann: Handbuch der Klimatologie, 3 vols., Stuttgart, 1910; reference in Vol. 2, p. 130.)

[2] The mean annual temperature of Tamatave, on the eastern coast, is 74° F., the extreme months being February, 80° F., and July, 68° F. The mean yearly rainfall is 115 inches.

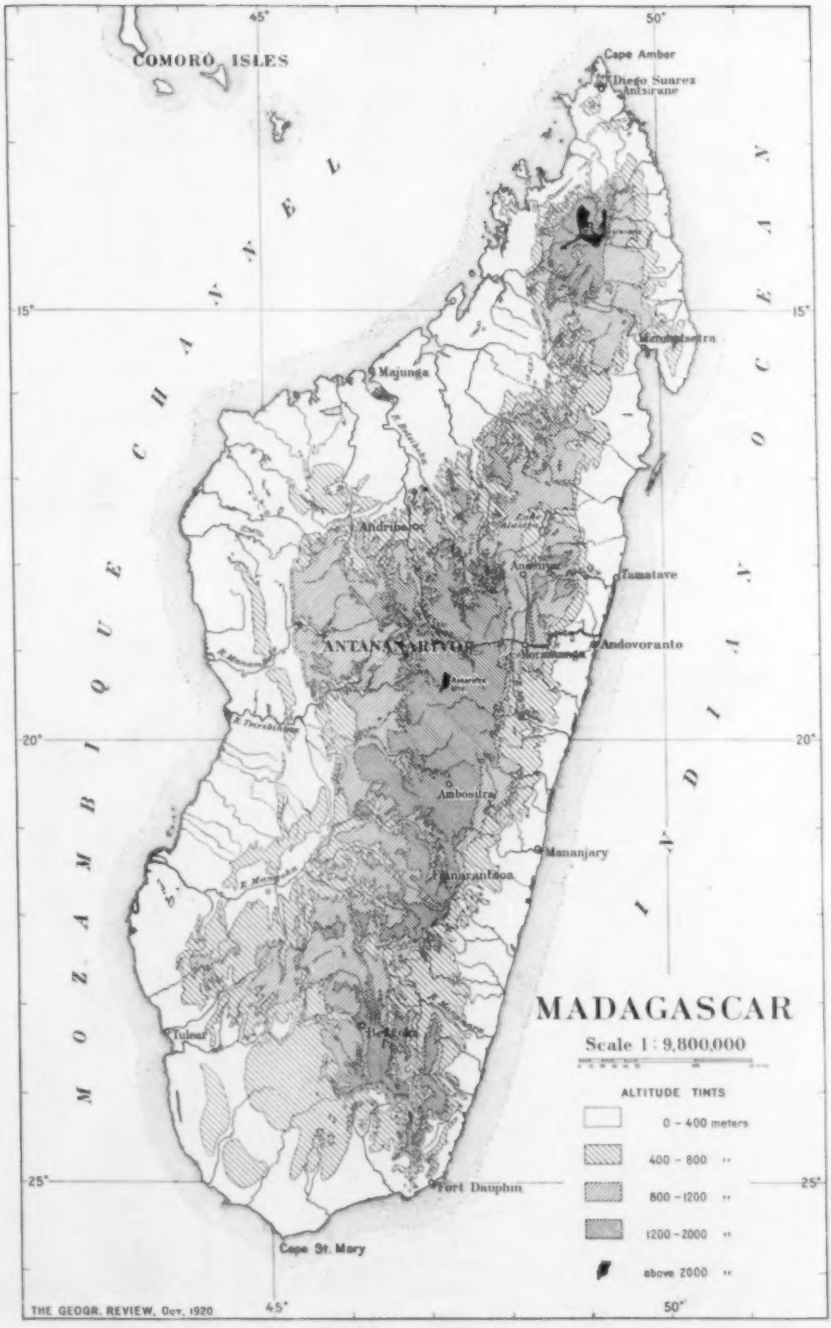

FIG. 1—Relief map of Madagascar. Based on Carte hypsométrique de Madagascar, by E. F. Gautier, 1902.

FIG. 2—Porters stopping for a meal by the roadside. A typical landscape in Imerina—rolling moorlike hills covered with short grass.

The Western Plains

The western region differs completely from those of the center and the east. In place of a chaos of mountains whose compact red soil supports either a verdant vegetation as in the east (where is a layer of humus, at once the product and in part the cause of the vegetation) or a meager growth of scant grass as in the center, here in the west are plains, gently rolling, calcareous or sandy, clothed in tall grass with palm forests and clumps of woodland. This is a region adapted to grazing, and herds of cattle are numerous.

The southern region presents the similar aspect of a slightly diversified plain, except in the eastern part which is broken by tolerably high hills. The south, however, is characterized by very great aridity, especially in the territories occupied by the little tribes known as the Antandroy and Mahafaly. In the vicinity of Cape St. Mary, for example, the numerous inhabitants are dependent on rain water as their sole source of supply, and sometimes rain falls only at intervals of many months. In this part of Madagascar all forms of life, the plants in particular, are adapted to a condition of drought, and in consequence the country wears a strange aspect comparable only to certain desert sections of Mexico and Central Africa.

The People: Their Distribution and Origin

The population of Madagascar is very unequally distributed, and the density is low. Although no exact census has been taken outside of the provinces of Imerina and Betsileo the total population of the island may be estimated at 3,500,000,[3] less than one-tenth the population of France. Of the total number the inhabitants of the Central Plateau, the Hova and the Betsileo, account for more than 1,000,000, and those of the eastern coast region for about 400,000.[4]

Today the people of Madagascar are collectively known as Malagasy, a name of foreign origin and comparatively recent introduction. Originally the islanders were divided into an infinity of little tribes, or one might rather say clans, absolutely independent of one another, each obedient only to its own chief. Connection between them was limited to frequent and reciprocal raiding for cattle and slaves. It was not until after the arrival of successive bands of immigrant peoples—Arabs, Indians, Malays, and Europeans—that the independent clans began to group themselves into larger bodies. The tendency towards grouping, however, has progressed apace especially since the eighteenth century, and there have thus been constituted the 17 principal peoples or tribes as they exist

[3] The official estimate for 1918 is 3,545,575 according to the figures quoted in *Suppl. to Commerce Repts.*, Ann. Series, 1920, No. 72 b, p. 10.—EDIT. NOTE.

[4] According to Lieut. Éd. de Martonne (La densité de la population à Madagascar; *Ann. de Géogr.*, Vol. 20, 1911, pp. 77–85; map) seven-tenths of the colony has a population of less than 12 to the square mile; one-tenth only has a population of over 25 to the square mile.

FIG. 3

FIG. 4

FIG. 3—On the road from Tamatave to Antananarivo: crossing the eastern wall of the central plateau by the pass of Angavo.

FIG. 4—Road through the spiny bush of Androy ("country of spines"), southern Madagascar. The vegetation of this subdesertic region is in complete contrast with that of the rest of the island.

FIG. 5

FIG. 6

FIG. 5—Wells in the dunes of the Mahafaly coast, southern Madagascar. Rain falls only two or three times a year, and all human life and activity is strictly dependent on the wells. Their stock is the chief resource of the population.

FIG. 6—Antandroy encampment on the shore near Cape St. Mary.

today. Of these the most important are the Hova, Betsileo, and Bara occupying the center of the island; the Antankarana in the north; the Betsimisaraka, Betanimena, and Antimorona in the east; the Antanosy, Antandroy, and Mahafaly in the south; and the Sakalava in the west.

The Merina or Hova

Amongst the divers tribes one proved itself more intelligent, better disciplined, and more powerful than the others so that it eventually succeeded in establishing effective dominion over more than half the island, while by a system of posts or skillfully distributed forts the other half was kept in check. Furthermore, for a century this tribe maintained a determined resistance to both French and English influence, playing off the one against the other, determined to yield to neither. This is the people known as Hova. They occupy the center of the island, Imerina, and have their capital at Antananarivo.

Fig. 7—Ethnographic map of Madagascar. The principal Malagasy tribes are shown. For details of distribution see: Alfred and Guillaume Grandidier: Histoire physique, naturelle et politique de Madagascar, Ethnographie, Vol. 1.

As a matter of fact the name Hova as applied in this sense to the population of the central plateau is erroneous. The Hova are only one of the three castes composing the Merina—the *Andriana*, or nobles; the *Hova*, or free men; the *Andevo*, or slaves. But this usage has prevailed, and hereafter we shall employ Hova to designate the entire population of Imerina.

Uniformity of Language and Customs

The traveler in Madagascar is invariably struck by the uniformity of the native customs and especially by the unity of the language—surprising circumstances when one considers that until recently intertribal communication was limited to plunder and raid. Yet throughout the length and breadth of the island we find a single speech varying from place to place only in pronunciation and in the words of foreign origin introduced by immigrant peoples or substituted for others whose usage has been

locally tabooed. This phenomenon has long been noted by sailors and travelers, who have further remarked the connection between the Malagasy tongue and Malayo-Polynesian dialects; but they failed to draw the conclusion, logical as it is, that the mass of the Malagasy have come from the Far East bringing their language with them. An explanation indeed had been sought in the supposition that the Andriana, who are generally known to be of Malay origin and who have imposed their authority on the Imerina and the neighboring regions, had at the same time imposed their language not only on these conquered peoples but also on all the other tribes of the island. On grounds that have already been suggested, and in the light of other facts, such an hypothesis is unacceptable.

Malayo-Polynesian Affinities of Malagasy

Although the Malayo-Polynesian affinities of the Malagasy language[5] have been recognized since the discovery of the island the blood relationship of the people with the Oceanic negroes, which agrees as well in respect of their physical characteristics and culture as their language, had never been affirmed or even suspected until deduced by Alfred Grandidier from his travels of 1865–1870.[6] As a matter of fact all the Europeans who had been in touch with Malagasy peoples, other than the Andriana and the chiefs of the principal tribes, had been struck by the color of their skin which is very dark without being the fine ebony black of the Senegalese and Sudanese. They drew the conclusion that the bulk of the Malagasy were African negroes, overlooking the fact that in Asia and Oceania there exist black peoples ethnically far more closely related to the natives of Madagascar.

One of the chief reasons for the general acceptance of an African origin for the Malagasy lies in the geographical situation of the island. Africa is comparatively near, and it seems natural enough that this continent should have furnished the first occupants of Madagascar. On the contrary the island world of the East is at an enormous distance, insuperable for primitive peoples—or so it may seem to those unacquainted with the regimen of the winds and currents of the Indian Ocean and with the history and customs of the Indo-Melanesians. The negroes of the coast of Africa, who are very poor mariners, do not venture on the high seas, and, furthermore, the currents in the Mozambique Channel are unfavorable to west-to-east crossing. On the other hand the Indo-Melanesians are excellent navigators, and the equatorial currents of the Indian Ocean bear directly on Madagascar. Pumice stone from the famous Krakatoa has been found

[5] As will be described later the Andriana are fairly pure-blood Malays whose forefathers arrived in Madagascar in the sixteenth century. The Malagasy language belongs to an early branch of the Malayo-Polynesian family.

[6] An appreciation of Alfred Grandidier's work on the ethnology of Madagascar may be found in the article "Madagascar," by W. H. Hunt, *Bull. Amer. Geogr. Soc.*, Vol. 32, 1900, pp. 297–307. For details of Madagascan ethnology see Alfred and Guillaume Grandidier: Ethnographie de Madagascar, 3 tomes, Paris, 1908, 1914, 1917 (constituting Volume 4 of "Histoire physique, naturelle et politique de Madagascar, publiée par A. et G. Grandidier," 59 vols., Paris, 1876–).

on the eastern shores of Madagascar and even further afield. It has, for instance, been reported from Port Elizabeth and mingled with it were seeds of *Barringtonia speciosa*. And historic examples are not wanting to show that man too can be carried westward by these currents.[7] At

FIG. 8—A Hova functionary and his wife. The upper classes of the Hova, the *Andriana*, are comparatively pure-blood Malay.

the beginning of the nineteenth century a Malay junk, caught by a storm off the Sunda Islands and carried westward, came to land at Tamatave.

THE QUESTION OF AN ABORIGINAL POPULATION

The question then arises as to whether the first Indo-Melanesian arrivals on Madagascar found the country empty or in the occupation of an abo-

[7] The outrigger canoes of Madagascar and the east African coast are derived from two forms both originating in Java. James Hornell: Les piroques à balancier de Madagascar et de l'Afrique orientale, *La Géographie*, Vol. 34, 1920, pp. 1–23.—EDIT. NOTE.

riginal population. No certain answer can be given, but if the island was indeed peopled the occupants must have been few in number and in a low state of civilization for they have left no trace either in culture or language.[8]

FIG. 9—Sakalava woman, hair loosened according to the custom in mourning. The Sakalava, occupying the western section of Madagascar, are one of the tribes descended from the early Indo-Melanesian immigrants who may be considered the basis of the Malagasy peoples.

[8] In "The Bantu in Madagascar" (*Journ. African Soc.*, London, Vol. 19, 1920, pp. 305–316) Emil Birkeli claims the recognition in western Madagascar of two different racial groups "both belonging to a low Negro type." Birkeli spent several years among the Wazimba of the Tsiribihina and Manambolo Rivers and also carried his investigations among the Bausi of the highland fastnesses of Bemara. The former are described as "lake dwellers" showing connections with fishing tribes of African origin, the latter as "cave dwellers" exhibiting parallel features with the forest people of eastern and central Africa and with the Bushmen. From the Wazimba Birkeli collected "tribes' names and traditions, special religious customs, list of words for utensils and plates, names of persons and places, and fragments of songs and prayers; all in a 'foreign' language, incomprehensible to the people of today." Fragments of ancient language were also collected among the Bausi. In an accompanying note Sir H. H. Johnston states as a conclusion that "the present mainly Indonesian population of Madagascar were almost certainly preceded by a Negro race." How such a people reached Madagascar remains a problem.—EDIT. NOTE.

FIG. 10—The Bara King, Impoinimerina, and his court, Fiherenana, a district of southwestern Madagascar. The Bara are amongst the least civilized peoples of Madagascar. Spear and gun proclaim their warlike attributes.

The Indo-Melanesian element may then be considered the basis of the Malagasy population. To it has been added another eastern strain by the Malay immigration of the Middle Ages. There is no doubt that the Andriana, or nobles, of Imerina are of pure Malay race. Anthropological study proves this in the clearest manner. At first glance it is impossible to distinguish a pure-blood Andriana from a Javanese. Andriana who went to Paris for the World's Fair of 1900 were invariably referred to by the man in the street as Indians and never as negroes.

The Malay immigrants soon abandoned the eastern coast, driven out either by the occupants or the insalubrity of the climate. They sought refuge in the inhospitable region of the central plateau scantily peopled by Wazimba. Superior in intellect and ability they gradually rose to a position of dominance over the peoples among whom they settled. The story of their progress, of the foundation and development of the Hova state, is not without interest for it explains the history of the conquest of the island by France.

Development of the Hova State

Early in the seventeenth century the Hova State, though restricted in extent, appears to have been firmly established. Ralambo, the second king of the Hova dynasty, had conquered Antananarivo, and with the fertile basin in which it lies, one of the granaries of Madagascar, it became the center of the kingdom. Ralambo gave special attention to the extension here of rice cultivation, the staple of Malagasy existence. Andrianampoinimerina, with whom the historic period proper may be said to begin, augmented the kingdom by the subjugation of the Sihanaka and the Betsileo, thus obtaining definite mastery over the central region. These peoples, however, though conquered were not subdued; and from his ascent to the throne his son and successor Radama I (1810–1828) was called upon to suppress rebellions among the Bezanozano and Sihanaka who sought to regain their independence. More significant, however, was the turn taken by external affairs—the arrival of English agents who entered into competition with the old established French interests.

Contacts with European Civilization

Under Radama the Hova were definitely brought in touch with European civilization. The sovereign devoted himself in particular to the furthering of education, opening schools for the instruction of adults as well as children. He sent nine young Hova to England to learn the more important trades, and many English artisans, among them the carpenter Cameron, were brought into the country. A practical result was seen in the progress of bridge building. For himself he had built by a French carpenter, Legros,

the pretty little palace Trano Vola ("silver house") and a country house at Soanierano, south of Antananarivo.

This taste for certain material products of European civilization was shared by Radama's successor Queen Ranavalona I, who erected the first great building in Madagascar, the Manjaka miadana ("reigning in peace

FIG. 11—A carrier of rush mats, eastern coast of Madagascar.

and prosperity"), an imposing monument and the most striking feature of Antananarivo, today dominating the humbler brick and wooden structures perched on the hillsides of this picturesque and strategic site. Under Ranavalona, Hova power and prestige was greatly strengthened. Antananarivo itself, which had hardly 15,000 inhabitants in 1853, boasted a vastly larger population at this time swollen by the presence of a garrison of 12,000 soldiers—a measure of the military expansion needed to keep pace with the ever-widening frontiers.

A Reactionary Queen

But in spiritual matters Ranavalona proved reactionary. In 1835 she began persecution of the Christians. Observances of the Christian church were forbidden, and penalty of death was proclaimed for those natives who professed Christianity, unless the "heresy" was renounced. Suspects

Fig. 12—Player of the *valiha*. This curious native guitar is made from the ultra-useful bamboo.

were subjected to the ordeal of the *tanghin*, or poison ordeal.[9] The *mpivavaka*, the native priests, were driven from Imerina, and the English missionaries likewise were expelled. "Blood—and always blood—is the maxim of Queen Ranavola, and every day seems lost to this wicked woman on which she cannot sign at least half a dozen death warrants."[10] On the

[9] "The Tangéna is a small and handsome tree growing in the warmer parts of the island, and the poison is procured from the nut of its fruit" (James Sibree: The Great African Island: Chapters on Madagascar, London, 1880, p. 281).

[10] The Last Travels of Ida Pfeiffer, New York, 1861, p. 212.

succession of her son Radama II in 1861 this retrograde policy was abandoned. Radama was the friend and pupil of the Frenchman Laborde, a man of great energy and resource, who was shipwrecked on the island in 1831 and remained there, figuring prominently for half a century in Madagascan affairs. Radama invited Europeans to Madagascar and sanctioned measures for European colonization. He opened schools and encouraged the preaching of Christianity. Catholic and Protestant missionaries alike were welcomed and given permission to establish churches in Antananarivo, a liberal attitude that roused the hostility of a part of the old régime. At the same time Radama II wrecked the stability of his kingdom by his lapse into a life of pleasure and debauchery. Retiring to the famous Trano Vato ("stone house") he abandoned the country to the rule of favorites. Before long rebellion was provoked in which the King was killed.

Opposition to French Influence

His widow Rabodo was proclaimed Queen under the name of Rasoherina, but the effective rule was in the hands of the Prime Minister as in fact continued to be the case under subsequent queens. Rasoherina's first Prime Minister was strongly opposed to French influence. When in August, 1863, Commander Dupré arrived with the Franco-Malagasy treaty, which had been prepared by Radama II and signed by Emperor Napoleon III, he found the new Prime Minister set against ratification. This involved the charter of the Madagascar Company previously granted to the Frenchman Lambert who had arrived simultaneously with several engineers to engage in the enterprise which was of an industrial and commercial character. Later an indemnity of 1,200,000 francs was obtained for the breaking of the charter. As a result of the incident, however, bitter feeling was aroused, and even after the exile of this minister English influence remained in the ascendant.

A treaty with England was signed in 1865 while efforts were still in progress to make the proposed treaty with France an accomplished fact. Comte de Louvières, sent to take up negotiations, met with an unfavorable reception. On landing he found that an edict had been promulgated prohibiting the sale of lands to Europeans and that the Malagasy army had been ordered to be in readiness in the event of war. During the course of the protracted negotiations that ensued the French plenipotentiary died. Before his successor arrived a treaty was signed with America analogous to that with England; but at last, in 1868 shortly after Queen Rasoherina's death, signing of the French "Treaty of Peace and Commerce" was effected.

Towards the end of the reign of Rasoherina's successor, Ranavalona II, trouble between France and the Malagasy government became acute, the crisis in particular arising over the attitude of the Hova towards the Sakalava of the northwest over whom France claimed a protectorate. Military

FIG. 13

FIG. 14

FIG. 13—Antananarivo is built on a long and lofty hill rising above flat rice plains. The most conspicuous feature of the town is the great palace, Manjaka miadana, about 100 feet long by 65 feet broad and 120 feet in height. To the north (left) is the Trano Vola. The great palace has been converted into a museum.

FIG. 14—The parade ground, Mahamasina, at the western foot of Antananarivo, and the little lake of Anosy.

intervention ensued and finally the Hova came to terms. A treaty establishing a French protectorate over Madagascar was ratified early in 1886, and a Resident was appointed, M. Le Myre de Vilers. The political situation however was not permanently cleared, although no open breach occurred for some years. Then one day several Frenchmen were assassinated, and it became obvious that war was imminent. To avoid so grave a contingency an attempt at conciliation was made anew by Le Myre de Vilers; but his overtures failed, and he with his compatriots withdrew from Antananarivo.

FIG. 15—A village of Imerina. On the barren upland of the central plateau the houses are built of adobe. The hard, compact red earth that forms so intractable a soil to the agriculturist offers, on the other hand, an excellent material for the mason—it has almost the solidity of stonework.

FRENCH INTERVENTION

An expeditionary force was organized under the command of General Duchesne. The marines were ordered to the immediate occupation of Tamatave, the chief port of the eastern coast, and of Majunga on the western coast. On February 12, 1895, the Queen held a solemn *kabary* in which she made an appeal to arms and decided to muster the Hova and Betsileo. On May 6 General Duchesne and the expeditionary force arrived at Majunga. Landing proved difficult; provisioning of the troops required construction of a cart road; arduous labor in a trying climate exacted a considerable toll from the troops although no enemy resistance was encountered for some 170 kilometers south of Majunga. Here a Hova force was routed, and General Duchesne proceeded with little opposition. A flying column was formed to cross the Ambohimena Mountains, the natural protective wall of Imerina. After some skirmishing the column

reached a point overlooking Antananarivo and the Betsimitatatra, the vast marshy plain out of which rises the hill upon which the capital is built. Turning eastward the little troop, without a blow, took Ambohidempona, some kilometers from the capital which from this point was within artillery range. The movement proved entirely successful. For defense reliance had been placed on the marshy plain which is one immense rice field, and the turning of the French force to the eastward was construed as a retreat. The appearance of the French troops at Ambohidempona took the populace by surprise. The first cannon shot paralyzed them with fear, and when

FIG. 16—A village in eastern forest belt, Vinanitelo, east of Fianarantsoa. The forest provides the material —bamboo, raffia, etc.—for construction of the houses.

presently a shell dropped near the palace the Queen hastened to raise the white flag. Thus ended the campaign.

REBELLION

On October 1, having installed himself in the Residency, General Duchesne contracted a treaty of peace. On the arrival of M. Laroche as Resident General the treaty which was reciprocal in character was modified into an act binding the natives to acknowledge the French protectorate over the island. But peace proved to be of short duration. Discontented Hova rose in rebellion, attempting a revival of their ancient pagan cult in the rural districts. A missionary, the Rev. W. Johnston, and his wife and daughter were killed. The insurrection was quelled, the Prime Minister exiled, and General Duchesne believing quiet restored left the country under the control of the Resident General. Then trouble broke forth again. The Hova had continued secret preparations for a "holy war," and Imerina from north to south was shortly aflame with insurrection in the course of which several Europeans were massacred.

The Advent of Gallieni

In August, 1896, France sent to Madagascar General Gallieni the valiant soldier and skillful administrator who had played so remarkable a part in French West Africa and in Tonkin. Gallieni reached Antananarivo in September to find all Imerina in open revolt. The situation was extremely bad. It had been still further aggravated by the sudden abolition of slavery, lightly pronounced by M. Laroche, and by the antagonism between the Protestant and Catholic missions. Without delay Gallieni summoned the Queen, who visited him as a vassal of France. Although without actual authority the Queen acted as the center of rebellion; hence it was deemed advisable to exile her, and shortly afterwards she was sent to Réunion. Meanwhile Gallieni proceeded to the pacification of the country.

In the campaign of 1895 the French troops had advanced from the coast toward Antananarivo. The pacification of 1897 progressed from Antananarivo as center towards the coast by the procedure known as the "oil stain." From a strongly fortified center are deployed a series of little posts whence pacification is extended in ever-widening circles. Thus Imerina was progressively occupied without the striking of a blow, the more easily so by reason of the policy of lending resources and financial help instead of extorting tribute as under the native régime.

Progress of Pacification

In the first half of 1896 only certain parts of Imerina and Betsileo were occupied. At the end of this year the French were masters of these two provinces with the two supply routes leading to Tamatave and Majunga respectively. By October, 1897, France had control over the entire north of the island, the province of Bara, and a coast zone extending to the southeast as far as Fort Dauphin. By the end of the year there remained only the extreme south and some points in Menabi on the western slope, and their conquest was completed in 1901–1902.

The method of pacification is described by General Gallieni himself[11] in one of his reports in which he addresses his subordinates significantly enough as his collaborators.

> The best method of pacification is to be found in the joint use of force and policy. In colonial campaigns destructive force should be used only in the last extremity and even then only that reconstruction may be the better. The country and its inhabitants should be treated with the utmost circumspection for it is to be the scene of colonization in the future, and its peoples will be the chief agents and associates in our enterprises to be undertaken therein. On every occasion when the exigencies of war compel a colonial officer to proceed against a village he should keep in clear view that, submission being secured, the first step is reconstruction of the village, creation of a market, establishment of a school. It is by this joint action of policy and force that pacification is accomplished and the way paved for the organization to which it later gives place.

[11] Compare the description of General Lyautey's pacification of Morocco, by Alfred de Tarde, in "The Work of France in Morocco," *Geogr. Rev.*, Vol. 8, 1919, pp. 1–30. Lyautey served under General Gallieni in Madagascar.

Roads and Railroads

While the troops were extending the limits of French authority workmen were engaged in road building to put the interior in connection with the sea, a task formidable enough under the conditions of climate and topography, especially on the eastern side of the island. Here an admirable system of roads now testifies to the triumph of the indomitable colonial spirit over the gloomy prognostications of friend and foe alike. On the

Fig. 17—A house of the eastern region; walls of bamboo.

western side, too, where surface and rainfall offer better conditions for road making and preservation, effort has been not less considerable.

In connection with the development of ways of communication note must also be made of the railroads, of which the chief is that from Tamatave to Antananarivo. In such a country as Madagascar the railroad is an important instrument of civilization. The course of construction provides large numbers of natives with a training of considerable industrial and moral value. When completed, the railroad furnishes a unique means of breaking down the barriers that isolate the native races and prevent the fusion of their common interests. On the economic side the Antananarivo-Tamatave railroad has provided an outlet for the best part of Madagascar. Imerina, isolated by nature, is the home of some million people, industrious and intelligent; who are, furthermore, the government's best auxiliaries for the economic and social development of the littoral and intermediate zones.

A

B

FIG. 18 A and B—Production of rice, food staple of the Malagasy. A. Oxen used in trampling the soil to prepare it for rice planting. B. Transplanting the rice. This is done after the summer rains have commenced (October and November).

C

D

FIG. 18 C and D—Production of rice. C. Terraced rice fields on a hillside in the Betsileo country. D. Transport of rice by canoe, vicinity of Antananarivo.

General Gallieni was not less occupied with the political and administrative sides of pacification. As order was established laws were framed to meet the requirements of the new situation. By a decree of October, 1898, a judicial service was instituted. Although the system is susceptible of improvement, nevertheless it has proved well adapted to native needs and has contributed no little to attach people to French authority. To give an idea of progress in this direction we may instance the following case. During the last days of the dictatorship of Rainilaiarivony, an uncle of Queen Ranavalona III, formerly a butcher and completely illiterate, was Keeper of the Seals of the Malagasy Government. A subordinate was charged with the august commission of guiding his hand when his signature was required!

Public Instruction

From modest beginnings, since the first schoolmasters were soldiers, heads of isolated posts scattered here and there through the island, public instruction has become one of the important departments of the present administration. Long before, it is true, missions of various nationalities had opened schools, but the instruction provided was essentially sectarian in character. As soon as the colony had at its disposition the necessary funds it not only drew up an official course of study for the free schools but also founded "government schools," which were strictly nonsectarian. The government schools are largely vocational, laying stress upon instruction in industry and agriculture and also in the French language. The professional school of Antananarivo under direction of the Department of Public Works has already trained tanners, weavers, potters, blacksmiths, watchmakers, jewelers, cabinetmakers, etc. That the students have gained a thorough knowledge of their trades has been proved by their work in the governmental shops, in their employ by private individuals, and in the businesses which they have set up on their own account. In 1914 the number of schools had grown to about 2,000 with over 150,000 pupils.

Improvements in Agriculture

One of the most striking results of French occupation is the immense impetus that has been given to native cultivation. Suppression of slavery had for its first result an increase in the number of landowners. Whereas formerly a free man and his slaves cultivated an area just sufficient for their support, emancipation released a large body of workers who took up unoccupied parcels of land to which they acquired proprietary title in return for rendering them productive.

If today in certain districts of the central region the price of rice has fallen to a few cents a *vata*, or double decaliter, it is because one no longer finds marshes with their stagnant waters. Every valley is drained, ir-

rigated, and converted into rice fields. As for the hillsides they are transformed with their cultivations of manioc, white and sweet potatoes, and groundnuts.

Labor

A vital question for every colony is that of labor. In Madagascar although not superabundant it suffices for present needs. Recruits, except in Sakalava where the population is sparse, respond readily to regular pay and good treatment. Yet, looking to the future the French government is not satisfied with the present sparseness of the population, which,

Fig. 19—A French fort in the western region of Madagascar.

as has been said before, numbers not much over 3,000,000. The people of the central plateau, the Hova and Betsileo, who represent so large a proportion of the population, are remarkably prolific, and maternity is in honor among the young women. But the children, ill-nourished, ill-clothed, ill-cared-for generally, not infrequently victims of superstitious practices, die in such great numbers that the peoples of the central region as well as those of the coast were well on the way toward extinction when the French government intervened on behalf of their physical and moral welfare.

How can the number of Malagasy subjects be increased? The answer is simple enough. The excessive infant mortality must be stopped. Among adults smallpox, malaria, syphilis, tuberculosis, and various epidemic diseases must be combatted. Such contagious diseases as leprosy must be isolated, and the general conditions of material existence ameliorated.

A Pasteur Institute established at Antananarivo in 1900 has furnished enough vaccine to permit the physicians of the health stations to inoculate the general mass of population. Today one hears no more of smallpox,

that frightful malady significantly known among the Malagasy as *lavara* ("stay-far-away"). To second the efforts of the Bacteriological Institute of Antananarivo another station was established at Diego Suarez, and smallpox disappeared from the Sakalava and Antankarana. Thanks also to the Institute of Antananarivo the plague, while still prevalent in Mauritius and India, has disappeared from Tamatave and Majunga. Hydrophobia, the existence of which in Madagascar has been denied, has on the contrary claimed a number of victims. The reputation of the Pasteur Institute has spread, however, and one frequently sees natives who have made journeys of several weeks for treatment. In 1902, through the use of the serum provided by the Institute, an epidemic of diphtheria was under control in a few days. Steps are being taken towards control of malaria along the lines which have proved so successful in Cuba and along the Suez Canal and in the Panama Canal zone.

In fine the history of the nine years during which Gallieni had in hand the destiny of the Great Island,[12] is a veritable epic achievement in its military, administrative, economic, and financial aspects. It has all been accomplished not only to the glory of the mother country but to the benefit of the land itself, in accordance with the practice of the Romans, the conquering and colonizing people *par excellence*, of the "politique des races."

Thanks to Gallieni and his distinguished successors Madagascar is today "France Orientale." The native population has accepted French authority, not only without recrimination but with a gratitude that was expressed in 1916 when 42,000 Malagasy volunteered in defense of the mother country. What better proof could be asked of the work of French colonization in Madagascar?

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[12] Joseph Gallieni: Neuf ans à Madagascar, Paris, 1908.

THE ARRANGEMENT OF RURAL POPULATIONS

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The distribution of population, which may be defined as the relative density of population per unit of area in different regions, has been the subject of considerable study by geographers. In many regions of a given density, however, the study of good maps of a scale of not less than 1: 100,000 will often indicate, while actual examination of such regions will confirm, the presence of a finer adjustment, which is expressed in a characteristic grouping of dwellings. To this grouping the term "arrangement" has been applied.[1]

During the course of the war, the writer was enabled to make extensive observations on the subject in Egypt, France, Belgium, and England, the results of which are of considerable interest. The evidence collected in the field was very striking, and a research into the literature of the subject which is available in Australia indicates that it has received very little definite recognition by geographers with the exception of those of the French school; who refer occasionally to agglomerations and disseminations, which are only the extreme types. Various writers dealing with particular regions refer incidentally to the grouping which prevails throughout or in parts of the regions concerned; but with the exception of the village community, which possesses an extensive economic literature[2] there has been no attempt to co-ordinate the various existing arrangements or to discuss their origin and significance.

It was evident at the outset that the geographic study of the arrangement of rural populations must proceed hand in hand with that of the historical and economic aspects of the question. Robinson's History of Western Europe[3] and Ashley's Economic History[4] served as excellent starting points in the latter respect. The geographic method was that followed by Privat-Deschanel[5] and Griffith Taylor[6] who begin with the natural region.

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[1] M. Aurousseau: The Arrangement of the Rural Population in Picardy and Flanders, *Geogr. Journ.*, Vol. 51, 1918, pp. 393–394.

[2] G. L. Gomme: The Village Community, London, 1890.

Paul Vinogradoff: Villainage in England, Oxford, 1892.

Frederic Seebohm: The English Village Community. Reprinted from the fourth edition (1905). Reissue, London, 1913.

H. S. Maine: Village-Communities in the East and West. 2nd edit., London, 1872. References to German authorities.

[3] J. H. Robinson: An Introduction to the History of Western Europe, 2 vols., Ginn & Co., Boston, 1902–04. Numerous references.

[4] W. J. Ashley: An Introduction to English Economic History and Theory, Vol. 1, Part I, London, 1913, Vol. 1, Part II, London, 1914. Numerous references to French and German authorities.

[5] Paul Privat-Deschanel: The Influence of Geography on the Distribution of the Population of Scotland, *Scottish Geogr. Mag.*, Vol. 18, 1902, pp. 577–587. Originally published in the *Bull. Soc. de Géogr. de Lyon*, Vol. 17, 1901–02, pp. 545–559.

[6] Griffith Taylor: Geographical Factors Controlling the Settlement of Tropical Australia, *Queensland Geogr. Journ.*, Vols. 32–33, 1918, pp. 1–67.

It was found that, at the present day, in civilized countries which possess a high degree of social freedom each natural region tends to develop a characteristic form of arrangement of its rural population, while in more backward countries social organization is a more powerful factor than physiography. The historic tendency is, in general, for an initial social arrangement to break down with advancing civilization and to be replaced by a more appropriate response to physiographic conditions. The geographer can therefore recognize at the present time various forms of agglomerations, partial agglomerations, and disseminations. They are not susceptible of systematic classification but are none the less real, being in each case a delicate expression of the social condition or physiography of the region concerned, or of both. In many instances arrangement in both the horizontal and vertical senses is discernible.

Agglomerations

The following forms of rural agglomerations are recognizable: small towns, villages, true village communities, and hamlets. In each case they owe their existence to some important social or geographic factor and, in themselves, exhibit an infinite variety of character and build, which changes from region to region.

Small Towns

Small towns are found in regions where the soil is very poor or restricted in extent; in oases, where irrigation is necessary for agriculture; and where defense is the prime necessity. As an instance of the first case we may take the country around Moscow, where the soil is so wretched—sandy or marshy—that rural industries entirely supplant agriculture and the whole population of the region has grouped itself into a number of small towns and villages.[7]

The oasis of Khargeh is an illustration of the second case, where the entire population of an area dependent on irrigation from an ancient Roman system of aqueducts and artesian wells has concentrated into one small town.[8]

In the mountainous regions of Algeria the population is grouped into small towns. Good soil is restricted in extent, and the need of segregation for defensive purposes is considerable. The arrangement, however, is eminently suitable to the population of fruit growers, whose farms are small and close to the towns.[9]

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[7] Alexander Woeikof: Le groupement de la population rurale en Russie, *Ann. de Géogr.*, Vol. 18, 1909, pp. 13–23.

[8] H. L. Breadnell: An Egyptian Oasis, London, 1919.

Mark Jefferson: Utah, the Oasis at the Foot of the Wasatch, *Geogr. Rev.*, Vol. 1, 1916, pp. 346–358, compares the Utah towns at the foot of the Wasatch with the Khargeh and the other oases of the Libyan Desert.

[9] Augustin Bernard and Edmond Doutté: L'habitation rurale des indigènes de l'Algérie, *Ann. de Géogr.*, Vol. 26, 1917, pp. 219–228.

Villages

Villages, other than those of frontier marches, which exist for defensive reasons, and those of backward, barbaric, or savage countries, or those resulting from some unusual physiographic condition, are very frequently survivals, though in form only, of ancient systems of government and social organization. Their origin, which has been discussed at length by Seebohm and others, is an economic problem, but their survival is a geographic one. With this we will deal in a description of Picardy and South Wiltshire.[10]

Village Arrangement in Picardy

The name Picardy, like many of the provincial names of pre-Revolutionary France (*noms de pays*), belongs to a fairly well defined natural region.

Picardy is a lonely-looking land of low, naked, rolling hills, cut by tortuous mature valleys. Here and there a village is seen, frequently nestling in a hollow and closely-circled by trees. Otherwise there is not a house in sight, though the greater part of the country is under cultivation. A winding belt of poplars marks a neighboring valley, and a regular row of elms reveals a main road on the horizon. Other vegetation there is none, save an occasional dense wood of young trees on high ground. One seldom sees old trees in France. The underlying formation almost everywhere is the chalk with flints (Senonian) of the Upper Cretaceous, which yields a poor and shallow soil on the terraced hillsides. Occasional patches of alluvial soil, *terre à betteraves*, exist, especially where the low hills expand into small plateaus. The climate is continental and humid, moderated by proximity to the sea but becoming more rigorous inland. The villages are compact, generally several kilometers apart, dotted over the land quite regularly, and connected by good roads, too numerous for inter-village communication alone. The land has hence a characteristic "knotted and netted" appearance. The farmer lives not on his farm, far from neighbors, in a bleak and melancholy country, but in the village, setting out daily with his team, one of the numerous roads serving his convenience.

The village arrangement in Picardy is a survival, though in form only, of the manorial system, in many cases of the Roman system, or even of the primitive village community. The very common terminations *-ville* and *-court* in place names and the château with its park testify in many villages to the former existence of manors or villas, while the universal occurrence of *remblais*, or terraces on the hillsides, and of embanked and sunken roads is evidence of the ancient open field system of cultivation. That the arrangement has survived long after the restriction of ancient land tenure[11] has been removed is explained by the physiography of the

[10] See also M. Aurousseau: A Contrast in Chalk-Lands, *Scottish Geogr. Mag.*, Vol. 36, 1920, pp. 158–161.
[11] Ashley, *op. cit.*, Vol. 1, Part I.

country. The chalk hills are dry, which is expressed in such place names as Sailly-le-Sec, Avesnes-le-Sec; and permanent supplies of good ground water are only obtainable in the valleys, or at the intersections of joints or faults in the chalk, or by the sinking of very deep wells.[12] Dwellings are hence concentrated around points of assured water supply. Horses are watered at the communal pond of each village, which contains water throughout the year and is fed by the run-off from the roofs and streets; but it is no uncommon sight to see casks of water being taken on sledges from the villages to the browsing cattle in the fields. The dew pond appears to be unknown. The country being agricultural, it has been necessary to spread the villages evenly over the land. Wherever possible, a low site has been chosen to ensure protection from the wind; but villages on elevated sites are by no means uncommon. All the villages are old, and increase in population is expressed by expansion of existing villages rather than by establishment of new ones. A variety of crops is grown, but the only important industries are the extraction of beet sugar and the manufacture of bricks. Occasionally, as where a small, swift stream has supplied power, a village has expanded into a small industrial town (e.g. Albert-sur-Ancre). In the east of Picardy and Artois the white chalk (Senonian) thins out, and the ground water level rises accordingly, permitting the existence of a few isolated farms and dwellings such as those around Le Cateau.

An arrangement which closely resembles that of Picardy is to be found on the same geological formation in parts of Hainault.[13]

Village Arrangement on the South Wiltshire Downs

South Wiltshire has many points of resemblance to Picardy but in other ways offers sharp contrasts. Its dominating feature is the chalk area of Salisbury Plain, a bare, rolling expanse of turf-covered downs, 500 to 800 feet above sea level and untilled except in the neighborhood of the valleys. The sweeping hills have a convexity of outline which is characteristic of chalk topography. The woods and copses are poor and scattered at random. The "Plain" is dissected by dry valleys, "winter bourns,"[14] and five small streams which converge on Salisbury like fingers joining a hand. The stream valleys are comparatively straight but are in the early stages of mature development, their floors of rich, deep alluvium stretching out into broad water meadows and wooded parks. The whole region is bleak and of more rigorous climate than the surround-

[12] Henri Hitier: Le village picard. *Ann. de Géogr.*, Vol. 12, 1903, pp. 109–119.
Albert Demangeon: La Picardie, Paris, 1905, pp. 372–386. See especially Fig. 27, p. 373, showing the phenomenon of agglomeration on the chalk plateaus in contrast with that of dispersion in the region of Normandy.

[13] Maurice Leriche: Les régions naturelles de la Belgique. *Rev. de l'Université de Bruxelles*, Vol. 19, 1913–14, pp. 5–217.

[14] W. H. Hudson: A Shepherd's Life, London, 1919.

ing districts; but the Plain is, and always has been, one of the most free and open regions of England. The most extensively developed formation is the chalk with flints (Senonian). Ground water is confined to the lower-lying areas in the valleys, and its absence on the high downs is to some extent compensated by the construction of dew ponds.

Salisbury Plain from the earliest times has had considerable interest in the present connection. This open spot in ancient, forest-clad Britain attracted an early population, traces of which such as the long barrows, round barrows, Stonehenge, and the early British earthworks of Yarnbury Castle and Codford Circle are abundant. In Saxon times the Plain was probably occupied under the tribal system. The Danes coveted the area and were met and beaten on it by Alfred the Great at Edington. The Romans occupied it extensively, as Old Sarum, traces of roads, and the remains of villas near Warminster testify. With the clearing of the valleys the population forsook the high downs, took to the low ground, and settled down to sheep farming and weaving, which persisted through the manorial ages until the industrial revolution.[15] Since then weaving has ceased, the old, horned downland sheep has become extinct,[16] and pastoralism is slowly yielding to agriculture.

At the present time, small, decadent, but beautiful villages are scattered along the valleys or nestle in lonely and sheltered spots. The only village on high ground known to the writer is Mere on the very southwestern corner of the Plain. Isolated dwellings are extremely rare. The villages of South Wiltshire are similar in origin to those of Picardy. They represent the surviving form of the ancient manors, many of the manor sites being still in evidence; while the occasional occurrence of *linchets*, which correspond to the *remblais* of Picardy, is an expression of the old methods of agriculture.[17] The village system is imposed at the present day owing to the exigencies of water supply. It is noteworthy, however, that, whereas the agricultural population of Picardy has spread evenly over the whole area and frequently occupies high ground, the pastoral population of Salisbury Plain is confined to the valleys and other low ground. From being formerly an attractive area to population the Plain has now become a relatively repellant area. This description is applicable to many other parts of the English chalk lands, especially in northern Hampshire.

Villages on Calcareous Formations

The two foregoing instances illustrate the extraordinary power possessed by calcareous formations in determining the survival of villages. Examples could be multiplied to such an extent that we can distinguish a class of

[15] Arnold Toynbee: Lectures on the Industrial Revolution of the Eighteenth Century in England, London, 1884.

[16] P. McConnell: The Elements of Agricultural Geology, London, 1902.

[17] Gomme, *op. cit.*

survivals which we will term the *lime land villages*. Gallois describes the parallel case of the calcareous plateau of La Beauce,[18] and Gravier notes the strong influence of limestone in parts of Lorraine.[19]

A further type of control exhibited by calcareous formations is to be seen in the *marginal girdle villages*, which occur on the spring line around the edges of many calcareous areas. For instance "in part of the Weald district the parishes are long and narrow, crossing the strike of the strata at right angles and securing to each a strip of sheep pasture on the chalk downs, a strip of dry but water-bearing rock suited for a village site on the Upper Greensand, a strip of stiff arable land on the Gault, and a strip of rough cattle pasture on the Lower Greensand, where the river runs with its water carriage and water power."[20] Again, in the region of La Vôge in the upper basin of the Saône a line of villages is found on the marls bordering the limestones on the left bank of the Saône and also on the western margin of the Vôge, where no less than 20 villages occur in a distance of 35 kilometers. Cereals are grown on the limestones while the marls are used for pasture and the sandstone for forestry.[21] A well developed belt of marginal girdle villages exists also around Salisbury Plain.

"Wet Point" and "Dry Point" Villages

Apart from the arrangements determined by the peculiarities of the hydrography of calcareous formations we have two special cases of arrangements governed by water supply—the extreme conditions giving rise to what we will term *wet point villages* and *dry point villages*. The former class is exemplified by the villages of the Grodno, Minsk, and Mohilev Governments in Russia, situated on the *terre noire* which provides but scanty and localized supplies of permanent ground water.[22] Woeikof also gives instances of dry point villages in the marshy regions in the south of Minsk, but the most striking case is that of the Nile Delta, which we will describe in detail.

The Nile Delta is an area of most unusual fertility, a flat expanse of deep, rich loam and black mud dissected by the uncertain branching river and cut by numerous canals. For the greater part of the year it is an emerald expanse of crops of infinite variety. The date palm alone, in clumps and groves, rears itself above the common level. There is nothing except the dazzling whiteness of a sheik's tomb or a drab mud village to relieve the eye of the green monotony until the distant line of the brown desert is reached. A complex system of irrigation has pushed intense

[18] Lucien Gallois: Régions naturelles et noms de pays: Étude sur la région parisienne, Paris, 1908; p. 55 *et sqq.*

[19] Gaston Gravier: La Plaine Lorraine, *Ann. de Géogr.*, Vol. 19, 1910, pp. 440–455.

[20] H. R. Mill: The Development of Habitable Lands: An Essay in Anthropogeography, *Scottish Geogr. Mag.*, Vol. 16, 1900, pp. 121–138; reference on p. 131.

[21] A. Cholley: La Vôge, *Ann. de Géogr.*, Vol. 23, 1914, pp. 219–235.

[22] Woeikof, *loc. cit.*

culture to the very border of the desert and beyond it. With water highways and primitive transport, roads are few and narrow. Irrigation channels and a few hedges are the only boundaries of fields. The climate is subtropical and rainless, with great ranges of temperature in winter.

The general landscape gives no adequate idea of the teeming population which lives in the thickly scattered villages. These are compact, crowded collections of small buildings, house next to house, made of sun-dried bricks and more or less walled in. The only isolated buildings are the white, domed tombs of sheiks. The villages are mostly situated on slight eminences composed of rubbish and representing the accumulation of centuries of building and rebuilding on the same site.[23] There are few large towns, and cities do not encroach on the valuable land of the delta. Cairo itself, situated at the apex, is extending a horn of suburbs to the northeast, not on the alluvium but between "the desert and the sown." This arrangement of dense nuclei, sited on mounds, without isolated dwellings, is rendered necessary by the extreme liability of the area to annual inundation.

Prolonged Turkish misrule has so effectively obliterated old institutions in Egypt that in Lane's time the *fellahîn* had been reduced to the condition of wretched laborers. They held no property, the land being in the hands of the pasha class or of foreign landowners. Now, however, the *fellah* is frequently a small landowner. The land is steadily passing back into Egyptian hands, but the liability to inundation will effectively block any tendency towards dissemination in spite of the increase of the number of small holdings.

Dry point villages similar to those of Egypt are found also in the low lying parts of Flanders, on the landward side of the dune belt. They consist of strings of houses built on dykes or canal banks out of reach of inundation.[24] In the same category may be placed villages situated on alluvial cones in the Alpine valleys. A classical example is seen in the Rhone valley in Valais where each cone has its village thus placed above the intervening marshy flats.

"Strong Point" Villages

Passing from the village survival, we will consider villages which have originated for defensive reasons. Defense is usually a secondary factor and is frequently no more than a temporary one. The villages south of the Oka, in Russia, were founded in the sixteenth century, land being granted in return for military services. The province was hence a frontier march. In the northern Caucasus also a similar state of affairs existed until 1864, when the land became secure and dissemination ensued with

[23] E. W. Lane: An Account of the Manners and Customs of the Modern Egyptians, 2 vols., London, 1837; reference in Vol. 1, pp. 28-29. On the village type in Egypt see also Jean Brunhes; La géographie humaine, Paris, 1912, pp. 135-141.

[24] Raoul Blanchard: Flanders, *Geogr. Rev.*, Vol. 4, 1917, pp. 417-433.

the production of small hamlets and isolated farms. The hamlets are proportional to the sizes of the estates.[25] Defensive villages are best developed in that shifting human region which exists on racial and international frontiers—the zone of strife. It has not received much acknowledgment as a human region. Such villages might well be termed *strong point villages*.

Villages owing their existence to special physiographic conditions are characteristic of areas of diverse physiographic elements, i.e. areas which do not form parts of well defined natural regions. They are extremely numerous, and the controlling factors are diverse. The studies of Faucher, and in particular of Sorre, are excellent in this connection. Faucher works out the siting of villages on the basis of soil, water supply, distribution of forests, etc., in Valence,[26] while Sorre has made a detailed geographic and historical study of part of Catalonia.[27] Sorre concludes that an historically uniform type is being replaced by a small number of forms geographically differentiated by concentration, at the expense of the intermediate elements (the hamlets). Rabot has carried out similar work in Sweden, where climate, soil, and the timber industry appear to be the important factors. He also remarks on the effects of calcareous formations.[28] The influence of powerfully developed physiographic features of an uncommon kind is well exhibited in the Norwegian fiord districts, where the small deltas at the heads of the fiords afford almost the only cultivable land and determine the sites of the small population centers.[29] Such centers may be termed *food point villages*, the occurrence of which might be expected in the borders of those regions particularly hostile towards man that Fleure has designated the "zone of hunger"[30] and on barren oceanic islands.

Village Communities

In barbaric and backward countries the village community is still in existence in many places. The conditions of social organization are such that the village arrangement is the only possible one, regardless of whether it be suited to the geographic conditions or not. Woeikof has described districts of the government of Kazan where the entire population dwelt in villages, where no personal property existed, everything belonging to the state or to communities of peasants.[31] In parts of Lorraine community

[25] Woeikof, *loc. cit.*

[26] D. Faucher: La plaine de Valence, *Ann. de Géogr.*, Vol. 23, 1914, pp. 127-150.

[27] Maximilien Sorre: Groupement des populations dans la Catalogne septentrionale, *Ann. de Géogr.*, Vol. 20, 1911, pp. 69-73.

[28] Charles Rabot: La distribution de la population en Suède en fonction de la constitution géologique du sol, *La Géographie*, Vol. 11, 1905, pp. 359-367.

[29] Hagbart Magnus: Zur Siedelungskunde von Norwegen, *Zeitschr. der Gesell. für Erdkunde*, Berlin, Vol. 33, 1898, pp. 367-392.

[30] H. J. Fleure: Human Regions, *Scottish Geogr. Mag.*, Vol. 35, 1919, pp. 94-105. This classification of world regions according to "the measure of the earth's response to man's efforts" has been noted in the *Geogr. Rev.*, Vol. 8, 1919, p. 277.

[31] Woeikof, *loc. cit.*

life still survives in many ways.[32] The villagers still work in common, though common cultivation has long disappeared. The villages of the plains in Palestine still preserve many common customs, the land being often owned by the villagers in common and a fair division of it taking place every year or two.[33] The Indian village community has been the subject of exhaustive study by Sir Henry Maine, who draws many western parallels from the works of Nasse and Maurer, and more recently by B. H. Baden-Powell, who has specially investigated the economic side.[34]

The village community must have existed in nearly every part of India, and there are abundant evidences of its survival. It is interesting, however, to note the exceptions which Matthai[35] quotes from Baden-Powell.

> First, the British Himalayan districts which contain a limited area of flat land and occasional patches of good soil on the hill side. People live here in single homesteads or in very small groups of two or three families. Secondly, along the west coast towards the south—the districts of North Kanara, South Kanara, and Malabar—the land here lying between the sea and the Western Ghat mountains is constantly intersected by hills and rivers and wide ravines. The inhabitants generally live in isolated homesteads, each with its own garden. Thirdly, the districts in the South Punjab below Multan where the country is so rainless that permanent cultivation is possible only under exceptional circumstances. To these may be added the tract of country along the North-West Frontier—Baluchistan, the North-West Frontier Province, and parts of Sind—where society is still organized in tribal rather than in village communities.

The village communities of savage and primitive races have been described by Gomme.[36]

The fate of the village community is invariably to disappear before the advance of ideas and to give way to the arrangement best suited to the geographic environment. The transition has actually been observed, as before mentioned, in the northern Caucasus but is best illustrated by the effects of voluntary and enforced enclosure of the common fields, which accompanied the agrarian revolution.[37] Slater's geographic study of the English parliamentary enclosures is noteworthy in this connection. He found, on plotting the enclosures, that they had a very definite distribution in an area stretching from Flamborough Head to the Solent, where the common field system had persisted in spite of all hostile attempts to crush it. He ascribes this to a high power of persistence which he considers the village communities of the area possessed by virtue of their origin and organization. It is remarkable, however, that the area of parliamentary enclosures corresponds to the distribution of the Mesozoic rocks in England, especially to the chalks, and it is probable that further

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[32] Gravier, *loc. cit.*

[33] J. D. Whiting: Village Life in the Holy Land, *Natl. Geogr. Mag.*, Vol. 25, 1914, pp. 249-314.

[34] Maine, *op. cit.*

B. H. Baden-Powell: The Land System of British India, 3 vols., Oxford, 1892; The Indian Village Community, London, 1896. See also John Matthai: Village Government in British India, London, 1915.

[35] Matthai, *op. cit.*, reference on p. 8.

[36] Gomme, *op. cit.*

[37] Ashley, *op. cit.*, Vol. 1, Part II.

investigations will ascribe the persistence to geographic environment, rather than to any peculiarity of organization of the communities of the area.[38] The great geographical result of enclosure upon the rural population was the development of partial or complete disseminations wherever the conditions were suitable, with the almost complete obliteration of the former system in many cases.

Hamlets

The terms small town, village, and hamlet are purely relative. They are of considerable use, but it is not possible to give them a quantitative value, except in local cases, such as the development of villages and hamlets on contiguous areas of good and poor ground respectively. Hamlets, however, are the normal agglomerations on the poorer class of ground which is not suitable for a disseminated arrangement. They are well developed in a region such as the Ardennes and occur frequently on the Russian plain. A striking example of agglomeration was noticed by the writer in the Belgian province of Brabant, between Brussels and Charleroi, on the gently undulating country of the Tertiary clays, but he was unable to investigate it. The Dutch province of North Brabant also exhibits an agglomeration developed to an extraordinary degree on Quaternary deposits. There exist in the province 184 communes, in each of which is a village. The land is divided into very small holdings, and home industries are very important.[39] Otherwise Holland and Denmark are lands where dissemination prevails.

The foregoing considerations have dealt only with the sedentary types of agglomerations, which are characteristic of temperate or fertile regions. In the regions bordering both the hot and cold deserts, there is often a semi-sedentary population, which changes its place of abode according to the seasons in pursuit of pasture. The tented nomads of the desert and steppe regions of Morocco and Algeria, who occasionally practice agriculture in a fitful manner, are typical of the borders of the hot deserts, as are also the inhabitants of the shifting tent villages of the more arid parts of the Mesopotamian valley. In Algeria there is also a more advanced population practicing agriculture within the 20-inch rainfall belt. As the villagers cannot maintain fertility in the soil for long periods, they dwell in hutments, which are easily transported to new areas when the old become exhausted.[40]

The case of the cold deserts is still more interesting, as an example of semi-nomadism in Europe. The regular migrations of part of the Swiss population between the valley villages and the châlets of the Alps are well

[38] Gilbert Slater: The Inclosure of Common Fields Considered Geographically. *Geogr. Journ.*, Vol. 30, 1907, pp. 35-55.

[39] H. Blink: Studiën over Nederzettingen in Nederland, *Tijdschr. Kon. Nederc. Aardrijk. Genoot.*, 2nd series, Vol. 21, 1904, pp. 1-45.

[40] Reference cited in footnote 9.

known, but an extreme instance is afforded by the Val d'Anniviers, where the number of groups of wooden dwellings, at different levels in the valley, which are temporarily occupied on a complicated system of migrations by the whole population at different times of the year, is out of all proportion to the number of inhabitants. The system of Anniviers is considered to be the outcome of increase in population in a restricted area from which there is practically no emigration.[41]

Partial Agglomerations

The area of Entre Sambre et Meuse (Belgium) is an example of a partial agglomeration with which the writer is familiar. Together with the district of Condroz to the east of the Meuse it forms a physiographic unit with a gentle general slope downwards to the northwest. It consists of a series of roughly parallel troughs and hills of long, rounded form, known locally as *tiges*, which have a general trend along the direction east-northeast to west-southwest. Though for the most part bleak and open, the country has well wooded belts which increase in extent to the south. The climate is pleasant in summer but represents the passage from the maritime Flemish plains to the rigorous Ardennes. The geological structure of the country is very accurately expressed in its physiography. The whole region lies in the Dinant basin, which consists of a series of subsidiary folds on the main, great syncline. Dissection has resulted in a number of parallel and alternating outcrops of schists (Upper Devonian) and limestone (Carboniferous).[42] The normal physiography of folded regions has here been reversed, the long elevations of the *tiges* coinciding with the anticlines, while the troughs have been carved in the synclines. Furthermore, good supplies of ground water are obtainable in the high-lying schists of the *tiges*, while they are not in the limestone troughs.

Here again the arrangement of the population corresponds closely to the physiographic conditions. It is essentially an arrangement of villages with intervening isolated dwellings, though the latter are not abundant. The villages have, in many cases, been forced to occupy the bleak tops and flanks of the *tiges*, in preference to the sheltered but often waterless limestone troughs.[43] Favorable positions for isolated dwellings are, however, by no means lacking, and there is a fair scattering of farmhouses between the villages. The rural occupations are more varied than usual. Though the country is essentially agricultural, forestry is very important. Iron ore occurs in the neighborhood of Gerpinnes but has not been worked since the opening of the Lorraine fields. A number of small Tertiary outliers provide opportunities for the working of plastic clays and glass

[41] Jean Brunhes and Paul Girardin: Les groupes d'habitations du Val d'Anniviers comme types d'établissements humains, *Ann. de Géogr.*, Vol. 15, 1906, pp. 329-351.

[42] M. Aurousseau: An Outline of the Geology of Entre Sambre et Meuse, Australian Corps, Belgium, 1919.

[43] Leriche, *loc. cit.*

sands. Potteries and brickworks are to be found at various points. The limestones are often quarried for building purposes and for lime burning, while the schists are worked for paving stones. Most of the older houses are built of stone in preference to brick, and the village streets are frequently cobbled. There is a tendency to plant forests on the high-lying Devonian schists (*végétation calcifuge*), while agriculture is practiced largely on the carboniferous limestones of the lower ground (*végétation calcicole*). The existence of so many rural industries has led to the formation of rather large, straggling villages and has rendered necessary a system of light railways.

Disseminations

The modern tendency towards dissemination usually achieves its most complete development on fertile ground. Disseminations generally result from the voluntary breaking away from older organizations in ancient countries, but under certain circumstances dissemination has been enforced. The normal method of settlement of the newer lands is by dissemination, though America was exceptional in that the early white settlement was under the village community system. We will examine three forms of dissemination which have been brought about by voluntary action.

Complete Dissemination: Flanders

The French part of the plain of Flanders constitutes about three-fifths of the Département du Nord and a small corner of the Pas-de-Calais. It stretches from the sea to the Scheldt and the Sensée. The landscape is flat and enclosed, with occasional noble vistas through the trees into green and fertile distances, dotted with red (thatched or tiled) cottages, and seldom broken by an undulation until the foothills of Artois are reached. The only feature of importance is the beautiful chain of residual heights stretching from Cassel to Kemmel and studded with windmills. Ditches and hedges line the roadsides and fields; sluggish brooks, tamed and canalized streams, and long canals traverse the plain. Woods are rare; but trees abound, distributed regularly around the edges of fields and along the roadways. Not an acre of ground remains untilled except the rich little pasture field on each farm. The roads are straight and tend to cross at right angles. The whole scene is one of checkerboard regularity and garden formality, recalling the picture-book landscapes of our childhood or the Solano target.

The predominant formations are soft clays (Lower Eocene—Yprésien). Though the soil is not of the best quality in itself, it has been wonderfully enriched by prolonged scientific agriculture. The climate is maritime, humid, and more temperate than that of Picardy. The waterways are seldom frozen sufficiently to bear a skater.

With a good soil, providing abundant ground water, holdings are small and every man lives on his farm. Ground water is so abundant that many of the farmhouses are moated, and all possess a pool. An elaborate system of draining and ditching is necessary. Mixed farming is practiced, under an intensive system of agriculture. The houses are so placed that there is easy access to all parts of the farm and to the neighboring road,[44] and they are so thickly and evenly scattered that true villages are often difficult to define. Small, straggling towns merge imperceptibly into the normal countryside. The general arrangement here, as in Picardy, gives the map a characteristic appearance, the regular intersections of roads and ditches giving rise, in such regions as that to the southwest of Armentières, to a series of perfect parallelograms, best seen on the 1:40,000 scale maps. Though Flanders was under the influence of the Roman and manorial systems, no trace of them is recognizable in the present arrangement, which may, however, have been facilitated by the fact that the one-field system—according to Seebohm—was in vogue in the region. We may regard the Flemish arrangement as a complete dissemination, but it must be remembered that the *close* settlement of the region was brought about by the conscious rise of Belgian agriculture in response to internal economic conditions and foreign relations. The whole of Flanders exhibits to a remarkable degree the effects of human occupation in the restraint and artificial modification of Nature.

Linear Dissemination: Landrecies

The country in the neighborhood of Landrecies affords an example of a linear dissemination which is none the less complete and is very striking, especially as the predominant formation is calcareous. This area lies to the east of the old provinces of Artois and Picardy and on the map greatly resembles them in topography. It is, in reality, a very different region. Whereas Picardy seldom rises above the 100-meter contour the relief of the present area lies between the contours of 140 meters and 210 meters. The greater elevation is not apparent, the dissection being more juvenile; and the broad, sweeping outlines of the chalk are far less pronounced. Surface water is much more abundant than in Picardy, the area being drained by a number of small, swift streams, which have a general northwesterly trend. They are the headwaters and upper tributaries of the Sambre. It is noteworthy that the average annual rainfall of Avesnes is from 800 to 900 millimeters—the same as that of Le Cateau, Arras, and Bapaume, which lie to the west. The landscape is enclosed, and distant views are only obtainable from the higher hilltops, whence the country stretches out as a gently undulating expanse of small, hedged pasture fields and orchards. Forest timber, as elsewhere in the Départe-

[44] Blanchard, work cited in footnote 24, pp. 420-423. A good illustration of the dissemination of population is given by Vidal de la Blache, La France (Paris, 1908), of the area round Cassel (Fig. 23).

ment du Nord, is confined to a few large areas, such as the Forêt de Mormal and the Forêt du Nouvion, an arrangement which appears to be the outcome of space economy.

The arrangement of dwellings is most remarkable. The numerous crooked roadways are everywhere lined with houses, which are often close together and are placed indiscriminately on the hilltops or in the valleys. They are seldom situated centrally on the holdings, which are frequently long and narrow and lie at right angles to the roads. The many places named on the map can hardly be regarded as villages, except where the intersection of roadways brings about a concentration of dwellings. The grouping might, without exaggeration, be termed linear. The explanation of it is not difficult. The white chalk (Senonian) of the regions to the west has given place to an argillaceous chalk (Turonian) which, as in England,[45] is less suitable for agriculture but yields here a sufficient supply of shallow ground water, provides excellent pasture, and is suitable for pome fruit culture. The local occupation is hence dairying varied with fruit growing; and the dwellings are so placed that the handling of farm products is reduced to a minimum. As in Flanders, all traces of the manorial system have been obliterated by a subsequent readjustment. The area extends somewhat beyond the limits of description and resembles the small Belgian region of the Pays de Herve.[46]

Incomplete Dissemination: Cornwall

Cornwall exhibits a dissemination which is not complete but which has advanced considerably beyond the partial stage. It is a country of strong, though not of rugged, relief. Its picturesque hills sweep from an embayed coast, abounding in drowned valleys, up to the high, rounded granite moors carpeted with gorse and heather. Its streams and wooded valleys are numerous and small, and the roads are like switchbacks. From high positions it spreads out a rolling expanse of greenery, divided into innumerable small areas by sinuous lines of stone walls, overgrown with brambles, hazel, dwarf oak, and a multitude of small flowering plants. The retarded denudation has resulted in a softening of general outline, slight aggradation of the valley floors, silting up of the headwaters of harbors, and a depth of good soil over the predominant, steeply inclined Devonian grits and soft slates. The climate is mild and maritime, with much wind and frequent rains.

The population of the slate and grit areas is purely agricultural, practicing mixed farming, while that of the granite areas and their vicinity is occupied in mining tin and china clay. Around the coast there is an important maritime element. The few large towns are on the coast or at the headwaters of harbors; the distribution over the whole country is

[45] McConnell, *op. cit.*
[46] Leriche, *loc. cit.*

hence fairly even. We are here concerned chiefly with the agricultural population of mid-Cornwall. True villages are few and far between. The usual so-called village is only a small, loose nucleus; and the greater number of names on the map apply to estates or farmhouses. It is probable that many such names are records of villages which existed formerly. They recall the place names in the Landrecies area. The arrangement of the population is a thin, fairly even dissemination with an occasional village. The houses are situated in positions of convenience on the farms, which vary in size from 80 to 400 acres, 120 acres being about the average. The houses are half a mile or more apart, except in the mining areas, where small rows of miners' cottages occur. There is no habitual selection of low sites, although there are sometimes limits to the supply of ground water. There is a large amount of common land and wooded land, but its distribution is such that it does not often modify the general arrangement. The original settlement of Cornwall was under the tribal system, which later gave way to the manorial system of which the estate and an occasional lonely church or place name are the present day representatives. Voluntary enclosure has brought about the present state of affairs. The system of rural land tenure today is one of leasehold, frequently for a number of lives, i.e. a farm is leased to a family for three or four generations. This system brings about a permanence of boundaries which is well expressed by the universal stone walls, known locally as hedges. This has perhaps retarded the tendency to complete dissemination, but it must be borne in mind that Cornwall is a thinly populated country. The survival of certain villages may be ascribed to the fact that the manorial population of the country consisted largely of cottars and bordars, and even at the present day the farm laboring class is a large one.

Enforced Dissemination: The Baltic Provinces

A striking example of enforced dissemination is seen in the Baltic countries of Esthonia, Livonia, and Courland, which together constitute a region of isolated farms. Dissemination in Courland dates from the seventeenth century. In these districts it has been brought about by the systematic action of the nobles of German origin, especially since the liberation of the serfs (1816–1819). Recognizing dissemination as the most advantageous form of occupation of the land, they proceeded in thorough Teutonic fashion to encourage or if necessary to force their tenants to break away from the old order, with complete success.[47]

Causes and Correlation

From the above consideration of various arrangements it would appear that definite grouping of rural populations is a conscious human response

[47] Woeikof, *loc. cit.*

to, rather than an actual physiographic control by, a number of factors in each region, chief amongst which are the following:

1. The type of pursuit to which the area is best adapted.
2. The nature of the ground water supply, rainfall, and surface water.
3. The quality of the soil.
4. The minimum size of holdings.
5. Space economy.
6. Any special local physiographic conditions.
7. The topography of the region, the effect of which is relatively slight.

It is possible to correlate freely developed arrangements to some extent with human regions,[48] village survivals, for example, being somewhat characteristic of the zone of effort while disseminations tend to occur in the zone of increment; but, as has been indicated, the factors which influence arrangement are so numerous that only the more extreme types are likely to exhibit any extensive development or broad distribution.

On a previous page it was stated that the various arrangements are not capable of systematic classification; nevertheless the following table was found extremely useful by the writer and is an attempt to express the relationships between the arrangements which have been recognized and their response to geographic environment. It is a recognition of system rather than an attempt at classification, as which it would be open to serious criticism. An American ranch, for instance, may really correspond to a wet point village; and a wet point village may, in turn, be also a strong point village. Any of the recognized forms of villages may occur under the heading "regions of diverse physiographic elements," and the vertical distribution of certain wet and dry point villages is not taken into account. Again, disseminations are linked with the zone of increment; but the Nile Delta, which is a typical zone of increment, has not developed a dissemination for very obvious reasons. The table does, however, bring out clearly the important fact that the human groups are the true subject of study, rather than the assemblages of dwellings by which the arrangement of the human groups is expressed.

The Capacity of Rural Districts

The study of natural regions and the arrangement of their rural populations is a matter of considerable importance especially in old and densely populated countries. There is necessarily a limit to the capacity of a region, and efforts have been made at different times to estimate the number of inhabitants a country will support.[49] This will depend largely on the

[48] Fleure, article cited in footnote 30.

[49] A. P. Brigham: The Distribution of Population in the United States, *Geogr. Journ.*, Vol. 32, 1908, pp. 380–389; reference on p. 387.

factors enumerated in the foregoing section and on the climate. As an area begins to approach its capacity, space economy will increase in importance and will react on the minimum size of holdings. This is already in evidence in Flanders and is becoming important in the Nile Delta.

AGGLOMERATIONS
Sedentary
Semi-sedentary (borders of zone of difficulty)
Mobile (of hot, subarid and arid lands)
Small towns
Strong point villages (zone of strife)
Village communities (tend to survive in form in zone of effort)
Villages (not necessarily surviving forms of village communities)
Villages
Hamlets
Lime land villages
Marginal girdle villages
Dry point villages
Wet point villages
(Of less fertile parts of newer lands)
Ranches (U.S.A.)
Haciendas (Mexico)
Stations (Australia)
(Of regions of very strong relief, and borders of zone of hunger)
Food point villages
(Of regions of diverse physiographic elements)
PARTIAL AGGLOMERATIONS
DISSEMINATIONS
Primary (of the newer lands)
Secondary (tend to develop in zone of increment)
Voluntary
Enforced

Dugard has shown[50] that a state of equilibrium exists in the Marrakesh region of Morocco between the number of inhabitants and the amount of arable land; and Breadnell states (*op. cit.*) that in the oases of the Libyan Desert there is a close correspondence between the population and the water supply. The necessary statistical study is rendered very

[50] Henry Dugard: Le Maroc de 1917, Paris, 1917.

difficult in the estimation of capacity, as administrative units rarely correspond in any way with natural regions. The only method open to the geographer is to make a statistical study of the smallest administrative areas of the country under consideration and to regroup them subsequently in such a manner that they will correspond as nearly as possible to the natural regions. The great difficulties of the subject have been examined and stated by Tronnier.[51] Such study is of great economic utility, however, and reveals in a startling way the reasons for the unnecessary depopulation of certain areas.

[51] Richard Tronnier: Beiträge zum Problem der Volksdichte, Stuttgart, 1908.

THE ENVIRONMENTAL FACTORS IN THE DISTRIBUTION OF ANIMALS

By Alexander G. Ruthven
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It is now recognized that American students of zoögeography are sharply divided into two schools on the interpretation of the distribution of the North American fauna. One group holds to the life-zone theory, with its fundamental tenet that the fauna and flora are grouped into transcontinental zones by the effect of temperature, the northward distribution of terrestrial animals and plants being governed by the sum of the positive temperatures for the entire season of growth and reproduction, the southward distribution by the mean temperature of a brief period during the hottest part of the year.[1] The other, and much the smaller, group believes that the facts of distribution do not indicate zonal distribution and that the facts of physiology and ecology do not warrant the expectation that given intensities of any one environmental factor will be found to exert a predominating influence upon the distribution of faunas.

It should be recognized that this difference of opinion and viewpoint at least augurs well for the advancement of our knowledge of the geographic factors; for, while it is well to draft theories on the basis of available facts, it is equally desirable that these theories be subjected to a most searching criticism. Unfortunately, there is reason to believe that among the students who have adopted the life-zone theory there are those who are considering as absolute truth that which is merely the accepted, and possibly erroneous, belief predominant at the present time and others who are unduly impressed by the fact that the theory has been adopted by an active and important government bureau.

Circumstances Giving Support to the Life-Zone Theory

There are other reasons, however, for the wide acceptance which the theory enjoys. Analysis of the geographic factors is proceeding very slowly; distribution of individual species is often limited to the north and south or connected with altitude in a way that suggests temperature control; temperature and other climatic conditions are important physiological agents and vary in a rather definite way with latitude, longitude, and altitude; data on the facts of distribution are still very limited; and the methods employed by advocates of the life-zone theory yield results which apparently confirm the theory. It need not be argued that the

[1] C. Hart Merriam: Life Zones and Crop Zones of the United States, *U. S. Dept. of Agric. Biological Survey Bull. No. 10*, Washington, D. C., 1898, p. 54.

objections to the theory, which concern both the facts and their interpretation, should not be lost sight of but may with propriety be emphasized and reiterated until satisfactorily met.

Objections to the Life-Zone Theory

Briefly stated, some of these objections are that the distribution of species apparently does not correspond to the accepted life zones as often or as nicely as would be expected; ecological studies yield an increasing amount of evidence that environmental factors other than the climatic ones may play an important rôle in distribution; and the data of physiology lead to the conclusion that a change in any environmental factor may make living conditions impossible. If these objections cannot be answered, the life-zone theory can continue to be held only by those who fail to resist the appeal of a dogmatism supported by extraordinary authority but largely based upon facts to which it is unrelated.

As has been intimated, there is an apparent zonal distribution of animals. It is a matter of common observation that as one ascends high mountains or journeys across the country from north to south or in the opposite direction certain species of plants and animals give way to others, and because the ranges of several conspicuous forms are frequently interrupted at about the same places it is the practice to consider the intervening area as a faunal region or zone. It is pertinent to inquire, however, whether the zones may not apply principally to the conspicuous forms; or, more broadly, one may ask what proportion of the organisms reacts to the changing conditions at the zonal boundaries.

Different Ranges in the Same Area

Very little study is needed to reveal the fact that the forms in the same area usually have different distributions; that is in a given region many species or subspecies fall short of, or exceed, the ranges of the conspicuous forms which serve as an index to the zones. It is not necessary to give specific examples, since the statement will not be controverted. Indeed it is definitely admitted in at least one report based on the life-zone theory, for, referring to the distribution of Texas animals, Bailey[2] states: "It [the Lower Sonoran Zone] is characterized by the following species, some of which fill the subdivision and are restricted to it, while many more are restricted to definite areas within its limits, and still others range beyond through one or more of the other zones."

It is believed that when the entire fauna is considered almost every region will appear as a transition area, the fauna being composed of three elements; forms which do not range beyond the area in a given direction, forms which do not range beyond it in the opposite direction, and forms

[2] Vernon Bailey: Biological Survey of Texas, *North American Fauna No. 25*, Biological Survey, U. S. Dept. of Agric., Washington, D. C., 1905, p. 26.

DISTRIBUTION OF LIZARDS AND SNAKES, DAVIS MOUNTAINS REGION, TEXAS

Altitudinal Distribution	Species (Italicized forms rare or secretive in the region)	Total Number of Species 33	More Common Forms in	
			Western Texas 24	Texas 25
Confined to lowlands below 3,600 feet on north (Lower Sonoran zone)	Cnemidophorus tessellatus tessellatus *Leptotyphlops dulcis* *Elaphe subocularis* *Elaphe laeta* *Lampropeltis splendida* *Ficimia cana* *Hypsiglena ochrorhynchus texana* Natrix sipedon transversa (a) Thamnophis proximus (a)	9	3	3 or 12%
Confined to mountains above 4,200 feet on north (Upper Sonoran zone)	Uta ornata (b) Plestiodon brevilineatus (b) *Plestiodon guttulatus* *Salvadora grahamiae* *Heterodon nasicus* (c) Thamnophis eques (b) Crotalus molossus	7	4	1 or 4%
Common to lowlands and mountains—both zones (*known to occur at least as high as 5,000–5,800 feet)	Coleonyx brevis *Holbrookia maculata maculata (d) *Holbrookia texana *Crotaphytus collaris baileyi (e) *Sceloporus torquatus poinsettii (e) *Sceloporus consobrinus consobrinus *Phrynosoma cornutum *Phrynosoma modestum *Cnemidophorus grahamii *Cnemidophorus sexlineatus *Cnemidophorus gularis *Coluber flagellum flagellum *Coluber taeniatus girardi *Thamnophis marcianus *Pituophis sayi Crotalus atrox *Crotalus lepidus (d)	17	17	21 or 84%

(a) Conspicuous habitat preference (semi-aquatic forms).

(b) Found in Lower Sonoran zone elsewhere in Texas (J. K. Strecker: Contributions to Texan Herpetology, *Baylor Univ. Bull.*, Vol. 12, No. 1, Waco, 1909).

(c) Recorded as occurring in Lower Sonoran zone in Texas (Bailey: Biological Survey of Texas, *North Amer. Fauna No. 25*).

(d) Recorded as occurring in Lower Sonoran zone in western Texas (Bailey, *op. cit.*).

(e) Conspicuous habitat preference (saxicolous forms).

which range beyond it in both directions. This general fact is concealed or its importance minimized by advocates of the life-zone theory by the practice of listing the species by zones. Yet it cannot be ignored, for to characterize zones by forms which do not approach their boundaries, or which exceed their limits, certainly does not throw light upon the authenticity of the divisions.

Need of Critical Distributional Studies

It is necessary to show that the zones express, at least with reasonable accuracy, the ranges of an unusual number of forms, if they are to have significance relative to the fauna as a whole. Unfortunately, but little attention has been given to conditions in the critical areas at the boundaries of contiguous zones, but at least it has not been shown definitely that a large part of the fauna of what are transition regions in the life-zone classification reacts to the particular changes in the one condition which is supposed to mark the common boundary of zones. As a contribution to this problem the writer offers the results of a critical study of the distribution of the lizards and snakes on the northern side of the Davis Mountains, Texas, where there are, according to the United States Biological Survey, two zones, Lower Sonoran and Upper Sonoran.

A Distributional Study from the Davis Mountains, Texas

In analyzing the facts of distribution set forth in this table it should be recognized, although this is not generally done, that the rare or secretive species are not significant and that their presence in statistical summaries is misleading and increases the chances of error already great enough from lack of data. The table shows that of the more common forms less than 30 per cent appear to be peculiar to particular zones if our knowledge of the distribution of the forms in western Texas is alone considered, and but 16 per cent if data on the distribution in a wider area are admitted. That is the ranges of only 16 per cent of the forms are limited in the region of the common boundary of the zones.

The arrangement of the forms in the table cannot be attacked on the ground that zonal boundaries are not exact and that the list of forms common to both zones has been increased by the inclusion of forms which only enter the lower part of the Upper Sonoran zone or the opposite, for a transition zone of 600 feet has been allowed. All of the species found in both areas are wide-ranging forms on the lowlands, and at least fifteen of the seventeen forms found in both zones have been found at the high elevations in the Upper Sonoran zone of 5,000–5,800 feet. It is admitted that the information is not complete because much is yet to be learned about the fauna, but it may be pointed out that life zones have been mapped for most regions on relatively less data than those used in this study, and, as the list of species evidently represents practically all of the common

forms of the region, there is no reason to believe that a greater response on the part of the fauna to the differences in conditions between the two zones will be discovered.

Any consideration of the possible factors in zoögeography must now take cognizance of the increasing amount of data which show that environmental factors other than the climatic ones control distribution and may even cause apparent zonal distribution of some forms. Thus Newman and Patterson[3] have found that soil controls the local distribution of the lizard *Sceloporus spinosus floridanus* in a region in Texas, and the writer has shown that the presence of rocks on the mountains and of fine soil in the valleys causes a differentiation in the distribution of several reptiles in Nevada into mountain forms and plain forms.[4]

It is admitted that when the ranges of a number of forms are limited at a certain place climatic factors may be the operative ones, but it is claimed that data on distribution are not sufficient to establish this fact. On the other hand, it is sometimes possible to demonstrate the occurrence of other geographic factors from the data of distribution, particularly if animals found in two zones but having a principal distribution in one region or the other are selected. The conditions in the Davis Mountains region (southwestern Texas) illustrate this point.

Ecological Factors as a Distributional Control in the Davis Mountains

Two of the species found in both zones (*Crotaphytus collaris baileyi* and *Sceloporus torquatus poinsettii*) are distinctly saxicolous in habits. These forms are common in the mountains but so rare on the adjacent hills and plains as to be easily overlooked. That climatic factors have little to do with this distribution, however, is clearly indicated by the fact that the species are relatively abundant on the plains in the few places where there are large rocks or small rock exposures. In other words the difference in the abundance of these species on the mountains and plains is evidently due to their choice of habitat and to the fact that the rocks have been largely destroyed or buried in the region adjacent to the mountains. It is also suggestive that *Crotaphytus collaris baileyi*, which is less of a rock climbing form but commonly lives beneath rocks, is more abundant and widely distributed on the plains than is *Sceloporus torquatus poinsettii* which is a strictly scansorial form. This would be expected from the difference in habits, since loose rocks are found later than cliffs in such a geographic change. It is not too much to expect that other less saxicolous mountain forms will also be found to be limited to the mountains because

[3] H. H. Newman and J. T. Patterson: Field Studies of the Behavior of Lizard *Sceloporus spinosus floridanus*. *Bull. Univ. Texas*, No. 137 (Sci. Ser. No. 15), Austin, 1909.

[4] A. G. Ruthven: An Interpretation of the Distribution of the Reptiles in Maggie Basin, Nevada, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 948–952.

their habitat is not represented on the lowland; and it may be added that two of the lowland forms, the semi-aquatic snakes *Thamnophis proximus* and *Natrix sipedon transversa*, have been found only on the larger bodies of water, making it possible that lack of food in the small mountain streams excludes them from the mountains. While the explanation of the distribution of these snakes is only a suggestion, it is a logical one in the light of the behavior of the saxicolous forms. It can receive confirmation, however, only from experimental studies.

Exception will also probably not be taken to the general statement that habits and habitats may control distribution. Thus Bailey[5] has stated that "In eastern Texas many species stop short of filling the whole humid area, and when their ranges are carefully mapped are found to be absent from, or in fewer cases to be restricted to, some of the following nonforested sections: the Grand and Black prairies of the Fort Worth and Dallas region; the coast prairie; coast marshes; islands and beaches." But it has been argued that such ecological data apply to local differences in distribution and that the differences in the environments are not those which prevail over a sufficiently large area to affect the whole range of a species. This is likely to be true, but if the facts are sufficient to show that such zonal distribution as occurs on mountains may not be due to climatic factors they certainly weaken the general theory to this extent.

Comparison of Phytogeographic and Faunal Divisions

There is, moreover, a larger aspect of the problem to be considered. If the distribution of the species of particular genera of land animals is examined, it is clear that the ranges are more liable to be affected at the place of contact of vegetation regions than on boundaries of life zones. Phytogeographers recognize divisions of the flora of North America which do not harmonize with life zones but more nearly correspond to physiographic regions.[6] It is believed to be significant that the species and subspecies of many genera of animals with terrestrial habits are apparently associated with these divisions, or, to express the facts more correctly, the forms of a genus frequently respond to the changes in conditions at the boundaries of vegetation regions by not going beyond them without change. It is not evident that comprehensive faunal divisions can be recognized on this basis, but it is apparent from the monographic revisions of genera which have been published that the boundaries of the vegetation regions are critical areas affecting a considerable number of forms. This would be expected on the theory that several factors may control distribution for, since there are a number of changes in the environments at these points, a larger number of species is affected than would be the case

[5] *Op. cit.*, p. 18.

[6] Compare the map of vegetation areas of the United States by Forrest Shreve, *Geogr. Rev.*, Vol. 3, 1917, opp. p. 124.

if only one factor were changed. If this explanation is true it would indicate that detailed studies of environmental conditions over large areas and of the physiology of the organisms dwelling therein will show that, as on mountains, the variation in any factor may control distribution and that the more numerous the factors which are changed the greater will be the number of species affected.

Physiological Ecology in Relation to Distributional Study

Physiological ecology is an aspect of zoölogy which has but recently come to receive the attention it deserves. As the study of the physiological relations existing between organisms and their environments, its data will provide a basis for the interpretation of the factors of distribution, and for the most part this interpretation must await the accumulation of ecological data. For this reason it is not possible, at present, as has been said, to prove that climatic factors are not the operative ones in controlling the distribution of forms which are confined to a particular region. However, since the effect of the inorganic contacts is largely physiological, we may well be guided by physiological facts in drafting our theories concerning the geographic factors and their operation. Physiologists have shown clearly that while temperature is an important physiological agent there are many other agents any one of which may be unfavorable at certain intensities. In other words, each environmental factor has an optimum intensity and unfavorably affects the animal at intensities either above or below the optimum.

Furthermore, it has been established that there are great physiological differences between species, both the optimum intensity of agents and the range of tolerance being characteristic for different forms. It is not necessary to illustrate these general physiological principles, but it is to be understood that the life-zone theory—that particular intensities of climatic factors exert a controlling influence on the distribution of many forms—is based on the assumption that many animals, or at least many terrestrial vertebrates, are physiologically similar in one respect, whereas there is no supporting physiological evidence for this assumption. If temperature changed suddenly and so radically as to surpass the range of tolerance of a large number of animals the life-zone theory would be more logical, but climatic variations are as a rule gradual.

Environmental Relations a Complex

From the ecological and physiological viewpoint it is necessary to consider the environment as a complex "the sum of all the contacts which an organism or a group of organisms establishes with the forces and matter of its surroundings, either organic or inorganic."[7] If the environmental

[7] E. C. Case: The Environment of Vertebrate Life in the Late Paleozoic in North America: A Paleogeographic Study, *Carnegie Instn. Publ. No. 283*, Washington, D. C., 1919, p. 40.

relations of an animal are a complex it must follow that the variation of any feature of the environment may alter the whole in a way disastrous to the existence of the form and may cause extinction or function as a barrier to migration or ecesis. This conception of the nature of the environmental relation together with the physiological diversity of animals negatives the expectation that any one factor will ever be found to account for the present distribution of a fauna. The apparent zones become in reality only the habitats of a limited number of forms.

It is possible that changes in temperature and moisture, either directly or through effects on the flora, are the factors which most often change the environments sufficiently to control the north-and-south and the east-and-west distribution of forms on great continents like North America, but this remains to be proved. Furthermore it is not evident that the considerable number of physiologically different forms composing the fauna responds to the same changes in the intensity of an environmental factor so as to permit of its division into zones. In ignoring the physiological and ecological data it is apparent that adherents of the life-zone theory are falling into the error of some anthropogeographers who, as Miss Semple has put it, "are prone to get a squint in their eye that makes them see one geographic factor to the exclusion of the rest; whereas it belongs to the very nature of physical environment to combine a whole group of influences, working all at the same time under the law of the resolution of forces."

In conclusion it may be pointed out that since the life-zone theory was first proposed the work of its advocates has largely been the listing of the faunas of the several zones and that nothing has been done to determine the effect of the assumed or other possible geographic factors. It needs to be understood that distribution cannot be explained by the mere mapping of the extent either of hypothetical faunal divisions or of species. The determination of the environmental factors is largely a physiological problem, and the data should be habits, habitat preference, analyses of conditions in the habitat, exact range, and the results of experiments upon the effect of altering the intensities of environmental factors.[8] Only harm can result from listing the forms by zones, for significant details of distribution are concealed, and the life-zone theory receives apparent but not real confirmation.

[8] The classified list of ecological problems given by Barrington Moore (*Science*, No. 1307, Vol. 51, 1920, pp. 67–68), while incomplete, may be accepted by the student of zoögeography as a guide to the problems whose solution will throw light upon the environmental factors of distribution.

THE PENCK FESTBAND: A REVIEW*

By W. M. Davis

The Man and the Volume

Let the memories of four painful years be set aside as far as possible while this well-earned tribute to a great geographer is reviewed. The volume opens with an address from one hundred and sixty-three of his former students—the list would have been significantly longer if the events of those obtrusive years had not excluded a number of non-Teutons—an address glowing with gratitude for the instruction and inspiration received by the disciples from their master and with enthusiasm for the subject which he has, in their opinion, done so much to raise to the rank of an independent science. They admire the broad range of his studies, developed chiefly in different phases of physical geography and extended into human and political geography; and they properly take pride in his numerous activities as teacher, organizer, explorer at home and abroad, and prolific writer. The many geographers of all countries who have had to do with Penck at international congresses and on distant journeys will recognize the justice of this tribute; for during the last thirty years his has been one of the most active and attractive minds in every gathering that he has joined. His scientific originality and his genial personality have been equally enticing. He used to be liked as much as admired, but during the war some of his statements have lessened the esteem formerly felt for him: into that matter we do not enter farther here.

The *Festband* contains twenty-two essays by as many writers and thus covers a wide variety of subjects. Morphology of the lands takes the lead with eleven; anthropogeography has three; hydrography and geographical education, two each; and climatology, economic geography, cartography, and method are each allotted one. All the contributions are serious, advanced studies. They give little indication that a fearful war was raging while they were written and published, although the otherwise surprising fact that only one essay deals with exploration in a distant region is perhaps thus to be explained. The effect of the war may, however, be recognized in having given opportunity during the German occupation of Constantinople for a study of the currents of the Bosporus by Merz and in having tempted Krebs, in the introductory phrases of his anthropogeographic study of the Balkans, to make the somewhat premature statement that the opening of that region is among the most valuable results

*Festband. Albrecht Penck: Zur Vollendung des sechzigsten Lebensjahrs gewidmet von seinen Schülern und der Verlagsbuchhandlung. xii and 438 pp.; maps, diagrs., ills. (Bibliothek Geogr. Handbücher.) J. Engelhorns Nachf., Stuttgart, 1918.

which the war has brought to "us Germans." All the essays deserve separate consideration; the present writer reviews three regional physiographic studies of limited districts in central Europe on the later pages of this article.

Domination of the Geological Standpoint

A careful study of these three essays and a general examination of the others suggests the question whether full warrant can be found for the assertion in the dedicatory address to the effect that Penck has raised geography to the rank of an independent science; for, like his own work as exhibited in numerous publications, many of the essays in the *Festband* are by no means freed from domination by geology. Just as the masterly investigation, "Die Alpen im Eiszeitalter," conducted by Penck jointly with Brückner of Vienna, is essentially a geological study, however interesting and valuable its geographical by-products are, so the work of his students as illustrated by several essays in the *Festband* appears to be concerned more with the evolution than with the description of land forms; and the evolution is treated largely from a geological standpoint rather than directed to a geographical end. Furthermore, not a single essay is devoted to full-fledged geography in the sense of giving a complete or regional account of a limited district, beginning with its physiography and climate and ending with its human inhabitants. The anthropogeographical study of the Balkans, above mentioned, gives, as is usual in such essays, no sufficient physiographic basis for its conclusions; and conversely the several morphological essays stop with land forms and do not go on to their human consequences.

It is indeed disappointing that a volume which celebrates the achievements of a leading European geographer should not contain at least one simple, direct, and competent study in regional geography; simple, in the sense of omitting all irrelevant geological and historical matter, however interesting such matter may be in itself; direct, in presenting the essentially geographical results that are reached by preparatory analytical discussions, while omitting the analyses and discussions that lead to the results; and competent, in showing a broad grasp of all phases of geography instead of specialization in one or more of its subdivisions. But, disappointing as the absence of such studies is, the same criticism would probably apply to the work of students trained under other modern teachers: their pupils too seldom become full-fledged geographers in the sense above indicated. Exception should be made, however, in favor of the late Paul Vidal de la Blache; his disciples have produced a good number of admirable regional volumes, although the authors of some of them, following the habit of gheir master, draw more largely upon history than seems desirable in pure teography.

The volume here reviewed is also disappointing in giving so much attention to the science of investigation as not to allow sufficient cultivation

of the art of presentation. Even in the mere matter of book making the needs of readers are not enough considered; for most of the essays are not well divided into sections, page headings give only the author's name and the title of his essay, and there is no index. In so far as the morphological essays which occupy half of the volume are concerned, they are not notable for clearness of exposition. All the essays reflect an enthusiasm for research, and that is excellent; but their authors do not seem to have devoted much thought as to how their results could be best set forth or as to how the essentially geographical elements of their results should be given due prominence. This is shown by the greater attention frequently accorded to invisible past processes than to their visible present products, as well as by the scarcity of outline maps and diagrams and by the commonplace quality of such diagrams as are included. The volume is not so great a product, geographically measured, as might have been expected.

The Harz Foreland

Three morphological essays are here selected for review, as being more in line with Penck's own studies than the essays on other subjects. One of them treats the southern foreland of the Harz Mountains, the second discusses the Vienna basin, and the third describes the Podolian upland in Galicia. The first, by Gisela Frey,[1] explains that the upheaved fault block of the Harz in central Germany, composed of deformed and greatly degraded ancient rocks, is bordered on the south by the broad and shallow Thuringian syncline, around which a resistant limestone forms an irregular cuesta. The northern arm of the cuesta trends to the east; the southern to the southeast; thus the two diverge eastward with the gentle pitch of the synclinal axis, and unite westward and are there extended in isolated tables along the gradual ascent of the axis toward the valley of the Weser. The weaker underlying strata between the northern cuesta arm and the Harz block are excavated in an open east-west depression, about 25 kilometers wide; this is the foreland of the Harz described in Frey's essay.

Structure and Development

The foreland is treated under three headings; structure and development, hydrography, and local features. The structure is more complicated to the east and west than on the south of the middle Harz; hence the central district may be taken as the simple type from which the eastern and western extensions depart in various ways. The structural description of the foreland and the adjoining uplands is highly geological in that it discusses the dates at which various complications of structure were produced and at which a peneplain was afterwards developed over the

[1] Das südliche Harzvorland: Ein Kapitel aus einer Landeskunde, *Festband*, pp. 135-159.

whole district. Half a page is given to prove that the peneplain is Eocene or older, thus emphasizing a purely geological problem, which, however important it may be in a morphogenetic analysis, has no proper place in a physiographic description. A later cycle of erosion, introduced by regional uplift, is now in an advanced stage; thus the hard and soft strata, which had been broadly truncated in the peneplain, again express their resistance or weakness in surface forms. The forms thus sculptured by normal erosion are more or less covered both by gravels and sands spread out by proglacial streams, and also by loess laid over them by the wind.

The hydrography is set forth chiefly in its existing condition with little regard to its development. The description of individual streams sometimes expresses an empirical structural relation, as where streams are said to be anticlinal or cataclinal; sometimes a genetic relation, as where they are said to be consequent or subsequent. The difference of treatment appears to be accidental rather than systematic and intentional. A closing paragraph briefly states that the present stream courses have been developed by erosion through a Tertiary cover which formerly overspread the now dissected or destroyed peneplain, and that various captures and adjustments to weak strata have taken place; but the visible landscape features associated with the captures and adjustments are not clearly set forth.

Local Features

Reference may be made to a few of the local features as samples of the rest. South of the central foreland, which is unsystematically dissected in low relief, rises the northern arm of the above-described cuesta, there bearing the names of Dün and Hainleite; it is maintained in somewhat irregular outline by the resistant Muschelkalk with a subordinate overlapping cuesta on its back slope. Here the dip of the cuesta-making strata is moderate and the cuesta upland is broad enough to retain traces of the ancient peneplain. To the east the dip increases, apparently because a small Harz-like mass, known as the Kyffhäuser, is upheaved near by. It may be noted in passing that the northern face of this mass is briefly described as a *Bruchstufe* or fault scarp; but, as the upheaval of the mass antedates the peneplanation of the region, the scarp must be due to erosion, not to faulting; and it therefore deserves a distinguishing name, such as fault-line scarp; its height is not a measure of the original displacement but of the difference of altitude between the uplifted peneplain and the present lowland. As if deflected by this uplift the cuesta turns to the southeast, and by reason of the steepened dip of its determining strata it is transformed into a narrow ridge, the Schmücke, across which the Unstrut, the chief river of the synclinal basis, flows out to the northeast on the way to the Saale and the Elbe.

To the west of the central foreland there is no exterior upheaval like the Kyffhäuser, and the strata outside of the main cuesta lie nearly flat;

hence the foreland here widens as the border of the Harz turns to the northwest. In the broadened space thus opened the Dün is fronted by two scarped uplands, maintained by residual patches of the cuesta-making limestones which are there gently warped down in faint structural basins; the smaller and eastern upland is the Bleicheroder Berg, the larger and western is the Ohmgebirge; farther to the northwest the scarped edge of the Göttingen upland is of similar origin. Just north of the Ohmgebirge the lower land is interrupted by a north-trending ridge, which represents a narrow down-faulted block, now standing in relief because the cuesta-making limestones are there depressed nearly to the level of the worn-down lowland surface. Singularly enough this ridge, known as the Klien, al-

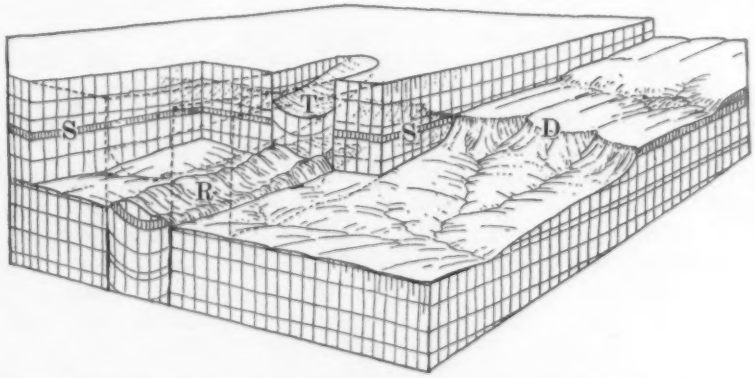

FIG. 1—The Klien, R, north of the Ohmgebirge, D, looking southeast. The Klien is a down-faulted block of synclinal structure, now standing in relief in virtue of its limestones being harder than the adjoining shales.

though it represents a structural depression, now forms part of the main divide between the Elbe and the Weser river systems. Farther west the frayed-out end of the Dün is extended at the apex of the main syncline by isolated outliers, influenced by unspecified structural complications.

CRITICISMS

In comment on this article it may be said that the author shows abundant familiarity with the field described and a trained competence in analytical discussion; but the pages on structure and development are, as above noted, too geological for a properly modernized geographical essay. They show, moreover, various indications of what may be called an "imperial provincialism"; that is, a tacit and probably unconscious assumption, often characteristic of untraveled geographers, to the effect that all the world must of course be acquainted with the general geology and geography of so important a region as their home area. Thus it is here assumed that every one must surely know that the Buntsandstein underlies the

Muschelkalk. The essay is thereby made less useful to the world at large than it would have been if the manner of treating local matters had been given what may be called "international consideration."

Need of Illustrative Diagrams

The description of areal subdivisions wisely avoids the introduction of village names as guides to the location of physical features; but, in using certain larger features as a means of locating various smaller ones, the text becomes fatiguing not to say obscure to readers who are not already familiar with the Eichsfeld, the Goldene Aue, the Windleite, and the Finne. Here the complete absence of graphic aids is lamentable. It may indeed be seriously questioned whether an essay in which the location of detailed features is thus treated in terms of little known larger features can be regarded as satisfactory from the reader's point of view. Several illustrative diagrams for special areas should be included, and at least one simplified outline map for the whole district, about such as the author could draw on a blackboard from memory, with the leading areal subdivisions and physiographic features indicated in as much detail as most readers will care to remember. By using such an outline and its subdivisions as guides all necessary physiographic items could be concisely located by the author and easily apprehended by the reader. The little extra labor expended in drawing such a map would be abundantly repaid by the gratitude of many a distant geographer; and it is good scientific economy for an author to undergo the labor, once for all, of thus making his pages easily intelligible so that many readers shall be spared the fatigue of trying to make out, each for himself, the meaning of obscure descriptions. Indeed, unless the author thus aids his readers their number may be smaller than he would like.

Even the greater labor of designing and drawing a diagram in explanation of so peculiar a ridge as the Klien would be warranted; for the conception and construction of such a diagram demand close attention to the facts and their meaning on the part of the author, and its interpretation yields a clear understanding to the reader. The diagram above presented, modified from an original drawn on the ground ten years ago by the late Professor Grund of Vienna, Berlin, and Prague is reproduced to illustrate the point. In this case the diagram is the more worth while because it shows that each side slope of the residual Klien is one of those physiographic rarities known as an obsequent fault-line scarp. If the author demur, saying "I can't draw," the Teutonic maxim may be administered: "You *can* draw, because you *must*." It was indeed under such disciplinary compulsion that Grund, who had not been in the habit of making similar attempts, designed his diagram during a field excursion. A year later he wrote from Prague: "I now use block diagrams frequently in my lectures and with much success."

The Vienna Basin

The essay on the Vienna basin, by Hugo Hassinger,[2] gives an elaborate account of part of a depression which lies between two extensions of the Alps, diverging northeastward on either side of Vienna. Its presentation lays a much stronger emphasis on the conditions and processes of the invisible geological past than on the conditions and forms of the visible geographical present. The treatment is advanced and detailed, the chief results of earlier studies being assumed as known in the intricate discussion to which the greater number of pages are devoted. The erudition of the author is unquestionable, but the geographical quality of his essay is for the most part obscure. Few distant geographers who begin the essay will persevere to its end.

Physical Features

Fortunately an illuminating account of the leading physical features of the district is given in the introductory pages; and from these, supplemented by reference to a good map, it may be learned that the Vienna basin, the southern part of a larger intermont depression, is a triangular area heavily aggraded and now having for the most part a plain surface. It is bounded on the west by a well-dissected fault scarp, trending north-northeast, 75 kilometers in length, by which the Alpine highlands are abruptly cut off, and is limited for 95 kilometers on the southeast by the lower Leitha range, which extends northeast toward the Carpathians. The basin is separated from the rest of the intermont depression on the north, known as the Marchfeld, by the Danube, which, entering from a narrow valley in the western highlands and departing by a short passage through the southeastern range, crosses the depression in a curved course, convex to the south, 55 kilometers in length. It may be noted that the situation of Vienna at the northwestern angle of the triangle, as well as the dimensional elements here introduced, are omitted from the essay as if they were of course known to every one; an omission which affords another illustration of "imperial provincialism." Perhaps, if the author were told that he ought to have specified the situation of Vienna in its basin for the benefit of his readers, he would have felt like Bret Harte's California miner, who exclaimed: "Didn't know Flynn, Flynn of Virginia! . . . Look'ee here, stranger, whar hev you been?" Yet it is probable that few of the world's geographers really know in just which corner of the triangular basin Vienna is situated.

Three unlike areas are distinguished. The southern angle of the basin is occupied by dry and gently sloping piedmont fans, composed of pervious gravels: here several streams follow narrowly incised trenches about 20

[2] Beiträge zur Physiogeographie des inneralpinen Wiener Beckens und seiner Umrandung, *Festband*, pp. 160–197.

meters deep, leaving undissected interstream spaces covered by heaths, fir plantations, and fields devoted to precarious agriculture. A middle area is covered with detrital deposits of much less thickness. Here the larger streams from the western highlands and several smaller ones fed by springs in the gravels flow in a bifurcating network through broad meadows of moist and fertile soil, in which fine-textured deposits underlying the inwashed gravels are disclosed and in which artificial drainage ditches are required. Residual patches of the gravel cover survive in low spurs and tables, 3 or 4 meters above the meadows, occupied by grain fields. In spite of its flatness, the old manorial estates of this district present a picturesque appearance. In the north the plain is benched by the terraces of the Danube; here the gravels of the southern angle of the basin are replaced by finer deposits of a considerable thickness as a result of the basin streams having been held back by ancient floods in the main river. The later entrenchment of the terracing Danube and the incision of many side valleys and ravines by the tributary streams give this area a hilly surface with a relief of from 50 to 150 meters. The chief stream of the basin, the Leitha, is pushed by the detrital fans from the higher western highlands close to the lower range on the southeast, and is peculiar in making its way through that range by an independent passage, 5 kilometers south of the Danube.

Criticisms: Use of Geological Terms and Explanations

The preceding paragraphs are chiefly abstracted from the first ten pages of Hassinger's essay, where many other details are to be found. The remainder of the essay is impenetrable without closer study than most geographers will care to give it. It is devoted chiefly to an elaborately analytical "history of the base level and the development of land forms in the Danube basin," in which the reader's attention is almost constantly distracted from the present and turned into the past. It abounds in the names of local geological formations, such as the Rohrbach conglomerate and the Laaerberg gravels, which can be properly understood only after a preparatory study of many special articles cited in the even hundred of supplementary references. The localities where deposition, deformation, or denudation has taken place and where various land forms occur, either within or without the Vienna basin, are inconveniently indicated by place names, of which as many as twenty may be counted on a single page. Some of the names are familiar, like Neusiedler Lake and the Iron Gate; but most of them are unfamiliar.

Nevertheless the analytical discussion here presented appears to have been conducted with competence and skill. New conclusions are announced at its close regarding the physiographic evolution of the Vienna basin as determined by various crustal warpings, for the discovery of which the author certainly deserves credit; but the discoveries are so involved with

geological complications that little if any geographical significance can be attached to them as they are now stated. Moreover, the essay illustrates to perfection that exaggeration of pseudo-explanatory physiographic treatment which makes the origin of a thing more difficult to understand than the thing itself. Indeed, if such an essay as this is to be regarded as geographical, then those are justified who claim that geography is only geology masquerading under another name.

A lesson may be here learned from the practice of astronomers, who in concisely announcing the elements of a comet's orbit do not include the elaborate mathematical calculations by which the elements were determined; or from the chemists, who in briefly stating the composition of a substance submitted for analysis say nothing of all the manipulations by which the composition was learned. Let morphogenetic geographers be as geologically analytical as they like and let them publish their geological analyses in appropriate journals if they wish; but, when it comes to presenting their geographical results, let their statement be directed to the manifestly geographical object of giving a helpful account of visible landscapes.

The Podolian Upland in Galicia

Lemberg, the capital of Galicia as things used to be, lies near the mid-European divide between the head branches of the Vistula flowing northwest to the Baltic and of the Dniester flowing southeast to the Black Sea. The Podolian upland, the longest of the Ukraine interfluves, extends far southeastward from near Lemberg, between the Dniester and its nearly parallel neighbor, the Bug. The Galician part of the upland and some associated areas on the northwest are described by Stefan Rudnyćkyj[3] on the basis of field work carried on through ten years preceding the war. Several subdivisions of the region are treated separately. Their form is first described, for the most part empirically but occasionally in explanatory style; then their structure is presented in geological terms; some morphogenetic paragraphs are added. Attention is given in this review to the Galician part of the Podolian upland proper, which measures about 140 kilometers in width between its limiting rivers and which includes 180 kilometers of its total length of 500 or 600 kilometers.

Physical Features

From the lower land around Lemberg, about 200 meters above sea level, a rapid ascent is made by a ragged, northwest-facing escarpment to the head of the upland interfluve, there about 400 meters in altitude. Thence the upland slopes very gradually to the southeast. The escarpment is not regarded as a cuesta face, for it is not determined by a resistant capping formation. Some of the former tributaries of the Dniester north-

[3]Die podolische Platte in Galizien, *Festband*, pp. 198–211.

west of the Podolian upland have been completely diverted to the Vistula; others, which head in notches in the upland scarp, have lost an undetermined measure of their former length. Hence the scarp may perhaps be the result of encroachment by lower-lying Vistula tributaries upon the upland area drained by higher-lying Dniester tributaries. The upland is composed for the most part of horizontal strata which exhibit, apparently as the result of advanced erosion in a former cycle before the uplift which prompted the river captures above noted, a gently undulating surface of low swells and shallow troughs with northwest-southeast trends about parallel to the main rivers by which the interfluve is bounded. Curiously enough it is drained for the most part by subparallel, south-flowing Dniester tributaries which cross the swells obliquely and cut them into short segments. No adequate explanation of these features is presented. Some of the segments are crowned by ruin-like remnants of reef limestones; each segment is usually higher in the northwest than to the southeast, partly as the result of unsymmetrical loess deposits. The shallow troughs lead longer branch streams from the northwest and shorter backhanded branches from the southeast, to the south-flowing rivers. Eleven of these rivers, from 40 to 130 kilometers in length, may be counted in Galician Podolia, and as many more farther southeast in Ukrainian Podolia. The members of the first group, of which the Sereth is a good example, wander in their upper courses on broad valley floors, which seem to date from the same cycle of erosion as that to which the swells and troughs owe their subdued expression. Farther down stream their courses are incised beneath the valley floors; there the streams flow in narrow meandering valleys which attain a depth of from 100 to 180 meters, with sharp-cut sides showing two terraces. The uplands are largely occupied with grainfields; villages with green gardens lie in the valleys even where they are deeply incised.

The pronounced entrenchment of the south-flowing rivers is a sequence to the even deeper entrenchment of the Dniester, which, long ago pushed away from the Carpathians by the detrital outwash of vigorous, square-branching tributaries from the southwest, now flows in a wonderfully meandering canyon, incised 200 meters or more beneath its former valley floor. The equal of this meandering canyon is hardly to be found in Europe. The river is still deepening its course and has few and narrow flood-plain scrolls; the steep walls of the valley are maintained by a hard red sandstone. The incised valleys of the larger tributaries steepen their fall as they approach the master river; the valleys of the smaller branches hang over the main canyon bottom.

Criticisms: Need of Location Maps

The above extracts suffice to show that Rudnyćkyj's article contains much matter of interest about a region little known physiographically;

but the article does not reveal a well-developed method of geographical presentation. Its descriptions are difficult to follow because, in the absence of a guide map, the names of villages and streams are used in locating boundaries and physical features. Not one geographer in a hundred—or a thousand—can use these local names to place the six areal subdivisions of the region, Roztoče, Ponyźe, Pidopil'e, Opil'e, Podnistrje, and Podil'e or Podolia proper. It is nothing less than self-deception for an author to think that his readers can follow the eastern boundary of Ponyźe, for example, when he tells them that it passes by Rudno, Hlynna, Pustomyty, Mylošovyči, Chorosno, Krasiv, Brodky, Demnia, and Mykolajiv. Even if the attempt is made to look up the place names thus used, few of them can be found on easily accessible maps, such as those in Stieler's atlas; indeed, it is difficult to find all of them, partly because of differences in spelling, among the countless other names that are given on the Austrian map of central Europe, 1:200,000, or on the larger-scale topographical sheets of Austria-Hungary, 1:75,000.

It cannot be believed that such use of these generally unknown place names to locate unknown physiographic features represents the best method of geographical description. It shows too little inventiveness because, in the absence of an outline map in the text, some plan for the verbal description of areas should have been devised in terms of contiguous triangles, semicircles, scrolls, and other readily conceivable patterns, within each of which various details might then be placed with as much accuracy as is conveniently attainable by words alone. It shows too much provincial introspection because, in the use of place names that are familiar to the author but unknown to practically all readers of his article, he fails to realize the small share of space and of attention that Galician Podolia occupies in the busy world. A much better method involves the use of an outline map as a graphic aid. In truth, when an author uses unknown place names as guides to the location of unknown physiographic features, it is tantamount to saying: "It is too much trouble for me to represent these features on an outline map or to define them verbally in terms of easily conceivable patterns; if you readers want to know where the features are, look up the guiding names on a map."

Lack of Attention to Geographic Presentation

That less attention has been paid in the preparation of this article to the art of geographic presentation than to the science of geographic investigation is manifest in various ways. The introduction of underground structure after the surface forms have been described is a curious inversion of a more reasonable procedure: for, if explanatory methods are to be employed at all, underground structures should be used as an aid in understanding the form of the surface, and hence structure should come before form. The frequent omission of details concerning the attitude, com-

position, thickness, and resistance of stratified formations is not compensated by the mention of their geological names; indeed, it by no means follows that such names, which have been invented by geologists for their own purposes, are the best names for the purposes of geographers. Certain passages in the text make it clear that the unlike requirements of geological and geographical presentation have not been mastered; it truly gives a learned appearance to a page to say that the marine Devonian beds which occur in southeastern Galicia have heretofore been erroneously ascribed to the Silurian, that certain strata in the upland represent the transition from the Mediterranean to the Sarmatian period, and that of the two terraces in the valleys one is young diluvial and the other old alluvial; but if the space thus occupied had been devoted to explanatory descriptions of more visible things—for example, to the reason for the oblique course of the south-flowing rivers with respect to the upland system of swells and troughs, and to specific accounts of the terraces as elements of the valley landscape—geography would have been the gainer.

Let the field work on which these geological statements are based be continued by all means; let the history of the changes that took place in Podolia during the Glacial period be worked out as far as possible, if the author's interest turns especially in that direction; but, if the author be a geographer, let all these studies and many more be pursued with a truly geographical object. Then, after the necessary field investigations are well advanced, let the geographical account of the region be freed from all irrelevant erudition so that single-minded attention shall be given to the facts of today; let these facts be presented according to some well-tested scheme, either empirical or explanatory; and let the presentation be easily intelligible, especially to readers who do not know the region, for in that class belong most of the geographers of the world. Instead of presenting the geographically useless information that the "Turon-, Emscher-, and Senonkreide" occur in Podnistje, or that certain Miocene beds in Podolia are covered with "sarmatischen Ervilien- und Serpulenkalken," the remarkable contrast in meander pattern presented by the Dniester before and after it enters the upland might have been described: in its upper course it winds freely on a broad flood plain in small, close-packed meanders, $\frac{1}{5}$ to $\frac{1}{3}$ kilometer in radius, the meander belt itself winding in somewhat larger curves; while in its lower canyon-like course, the meanders are much larger, being 1 or 2 kilometers in radius, and the river there vigorously swings around the spurs and undercuts the great amphitheaters, alternately right and left, in thoroughly competent fashion.

A Questionable Statement as to Erosion

With increased attention to these physiographic matters, correction might be made of a questionable statement in a final paragraph to the effect that, while downward erosion is still operative in the winding Dniester

canyon, lateral erosion is as yet imperfectly developed; for unless this river is unlike many others of similar appearance—for example, the Seine and the Mosel—its lateral erosion, outward on each meander and down-valley on each tangent, has already exceeded its vertical erosion. Unintentional testimony for the outward expansion of the meanders by lateral erosion is given in the mention of the two terraces on the slope of the meander spurs; but nothing is said of the expectable contrast between the steeper slopes of the undercut, up-valley sides of the spurs and the gentler slopes of the slip-off, down-valley sides, although this contrast is strong enough in certain other incised meandering valleys to determine that the steep slopes shall be left to tree growth, while the gentler slopes are cleared and cultivated.

It may perhaps be objected that the foregoing pages overemphasize the importance of presentation as compared with investigation. In reply it is recognized that while original research is of course the prime essential of scientific progress, and while the scientist who conducts the research profits by its successful prosecution, the world at large will know nothing of it until it is communicated and even then will not know the truth about it unless it is communicated properly. The first requirement of investigation is that its results shall be correct and accurate; similarly, the first requirement of presentation is that its statements shall be clear and intelligible. The former promotes the increase of knowledge; the latter promotes the diffusion of knowledge. Each process should be developed to best advantage. The essays above reviewed give abundant indication that their authors were careful and competent in the conduct of their investigations. Not so much can be said as to their skill in the presentation of the results of their investigations.

THE CULTURE OF THE AMERICAN INDIAN: ITS REGIONAL DISTRIBUTION AND ORIGIN*

Human geography seeks interpretation through terms of the past as well as the present. The long continuity of local culture has been a potent factor in fostering the progress of human geography in Western Europe In contrast a cataclysmic break separates the indigenous culture of America from that of the modern western world; this undoubtedly is partially responsible for our tardy interest in human geography. Yet we may question whether the break is quite so cataclysmic as it seems at first glance.

Indian Culture in Relation to Modern Civilization

The Indian indeed has vanished, or practically so; but what of his cultural achievements; do they leave no heritage for the regional successors? Even in offhand fashion this can be answered by reference to the cultivation of various indigenous plants, first and foremost of maize. The present-day economy of the Middle West is primarily founded on maize. And the debt to this aboriginal cultivation is still growing. Modern plant breeding utilizes the possibilities of the maize of the Titicaca basin that long cultivation has developed to withstand the high altitude cold. In Dakota a student of Indian life has lately conceived the idea of training the farmer of the northwest to raise maize, in spite of the shortness of the season, by use of methods anciently worked out by the Indians of the locality.

For a more complete appreciation of the debt of our civilization to Indian culture, "too virile and too finely adjusted to local geographic conditions to be obliterated," the geographer must turn to the anthropologist. Here he will find a comprehensive study to hand in the recent work of Clark Wissler, "The American Indian." It is a result of the fruitful method of modern anthropology that "commits us to a historical and geographical point of view." Herein classification finds its basic principle in geographical distribution, for the anthropologist has learned, according to the phraseology of Marett, "to work all the time with a map of the world at his elbow."

The Culture Regions

First we have the mapping of separate cultural elements. Most tangible and objective of all are those having to do with food. The map of the

*Clark Wissler: The American Indian: An Introduction to the Anthropology of the New World. xiii and 435 pp.; maps, diagrs., ills., bibliogr., index. Douglas C. McMurtrie, New York, 1917. $3.00. 9 x 6 inches.

distribution of staple food resources gives, in fact, the general lines on which the cultural grouping as a whole is laid down (see Fig. 1). Consideration of the sum total of cultural traits gives rise to an accepted classification of the New World into 15 cultural regions. They are shown on Figure 2. These areas, like all objective distributions, are not susceptible of rigid delimitation. A culture area indeed is defined rather by its center whose geographical position is coincident with the habitats of the most typical tribes than by the periphery. The culture areas thus defined relate to historic time. Similar archeological areas may be determined. A comparison of the two is interesting. With the exception of Central America and the eastern maize area of the United States there is very close agreement among them, suggesting that in some way a type culture is fixed in its locality. This naturally brings up the question of the influence of environment.

Wissler stresses environment as the static factor. It does not produce the culture but furnishes the medium in and by means of which the culture flourishes and tends to hold it there when once rooted. The tribes occupying any of our culture areas make use of a certain number of the possibilities presented by that area and specialize in these, and they are perpetuated as social habits that resist change. Cultures appear to expand to the geographical limits of the environment in which they have originated but do not readily pass beyond. Blood and language may more easily be carried over. Until the appearance of the white man in America there were no sudden invasions of new races, and groups migrating from one culture area to another seem to have been rapidly assimilated culturally. Moreover, in regard to the regional distribution of blood and language highly interesting conclusions have been reached, though these are strongly controverted. It is asserted that the various language stocks show a grouping that tends to be coincident with that for the culture characteristics; and even the somatic type, a biological characteristic, is regarded as exhibiting a tendency to conform to the environmental area. But these tentative conclusions await further research for confirmation or disproof.

New World Origins

The ultimate goal of the anthropologist is the discovery of the origin of his subject, and here we must turn to the world map, first however recognizing a fundamental feature of the anthropology of the New World as a whole. This is its essential unity. For the higher cultures of the New World an extraneous origin has been sought: but this is not necessary. Mexico and Peru are merely the centers where the characteristic culture traits of the New World reached their highest development. Proceeding outward we may trace their fading parallels. This is true of such material traits as agriculture, metal work, ceramics; and it is still clearer in the case of the less material traits. Society is composed of the same kinds of units,

FIG. 1—Map showing distribution of the staple food resources of the aboriginal peoples of the New World (drawn with slight modification from Fig. 1, p. 8 of Wissler's "The American Indian"). The eight areas may be grouped thus: three are the homes of hunting peoples; three of agriculturists; one of fishers; one of gatherers of wild seeds. In regard to the caribou area it should be noted that though the seal plays so large a part in Eskimo economy, the caribou is also an indispensable resource.

FIG. 2—Map showing the culture areas of the American Indians. The areas are defined by the typical groups at their centers: the boundaries are relative only, for the areas merge at their edges. In his map (The American Indian, Fig. 67, p. 205) Wissler's boundaries are geometrical lines. They have here been modified in accordance with data contained in the text and with the boundaries as shown in Wissler's earlier map, the Culture Areas in North America, North American Indians of the Plains, Handbook series No. 1, American Museum of Natural History, 1912.

conceptions of property and political rights are similar. New World culture may be depicted as "a kind of pyramid whose base is as broad as the two Americas and whose apex rests over Middle America."

With this essential unity in mind we may pass to the problem of New World origins. The somatic characteristics of New World man proclaim his affinity with the Mongoloid peoples of Asia. The problem resolves itself into the question of the date of his arrival in the New World and the equipment he brought with him. Wissler's conclusion is that we must postulate an early date for the arrival and a state of culture little advanced; we must, in fact, concede Interglacial man in America. The traits brought over from the Old World were of man's early heritage, the fire drill, stone chipping and polishing, perhaps domestication of the dog, and so forth. The more advanced of the fundamental traits of New World culture are, on the contrary, distinguished by their originality.

The high centers of the New World must then be conceived of as parallel to, not derived from the high centers developed by the Mongoloids of the Old World. In the New World the fundamentals of Maya culture can, as we have already stated, be found among the less advanced people. There are similar evidences that Chinese culture sprang from original Mongoloid groups settling in the valley of the Yellow River. The Chinese center received stimuli from other non-Mongoloid cultures: the Maya center was cut off from such favorable influences. The geographical situation of these two complex and independently developed cultures calls for the assumption of a northern cradle from whence the two migratory groups would set forth. Study of New World origins takes us back from Mexico and Peru into the heart of Asia.

GEOGRAPHICAL RECORD

NORTH AMERICA

Physiography and Life Zones of Panama. The reports of the Intercontinental Railway Commission and the studies of the Isthmian Canal Commission have given us at least the outlines of the physiography of Panama. But in an important paper by Edward A. Goldman (Mammals of Panama, *Smithsonian Misc. Colls.*, Vol. 69, No. 5, 1920) we have our knowledge of the physiography applied in the biological field in a manner of special value to geography in that the text is illustrated by a life zones map which is here reproduced. The author conducted a biological survey of Panama, visiting among

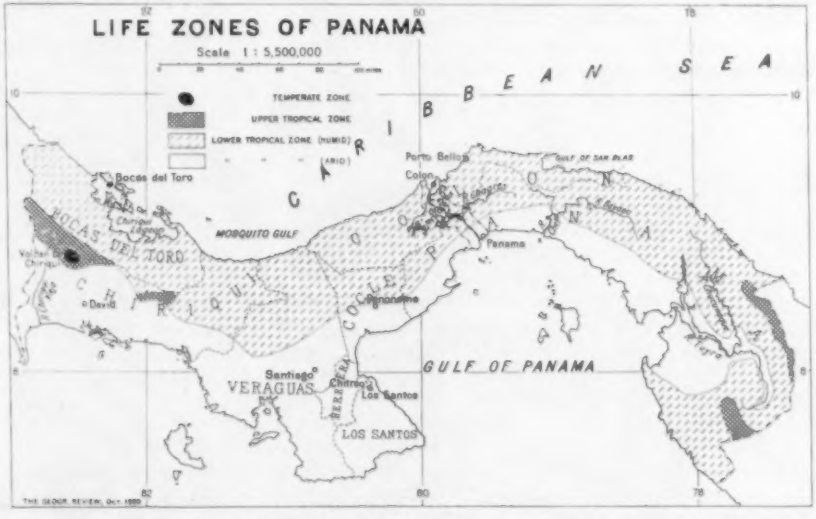

FIG. 1—Map showing the provisional life zones of Panama (after that accompanying the paper cited in the text).

other places the Chagres region, Porto Bello, and eastern Panama. He points out that large areas, including important mountain ranges, remain unexplored. One of the parts least known is the area controlled by the San Blas Indians from which other native tribes and foreigners have been consistently excluded (see S. P. Verner: The San Blas Indians of Panama, in the July number of the *Geographical Review*).

After treating the physiography of the Isthmus of Panama the author passes to the climatic conditions and their faunal relations. So far as the natural life is concerned the study has a peculiar timeliness because the republic of Panama is still sparsely populated, clearings are few, and the natural life as yet relatively undisturbed. The region is especially interesting from the standpoint of biogeography because it is a meeting ground of forms from South America and North America. In Tertiary times oceanic waters probably extended across the isthmus in a number of places—certainly across the Canal Zone, which forms a distinct faunal boundary. For the region as a whole the fauna is so diversified and as yet so little known that any classification into life zones must be regarded as

tentative in character. Three provisional life zones may be recognized. Their characteristics are summarized below:

1. *Lower Tropical Zone.* An area of high temperatures, including by far the greater part of the isthmian land surface. It extends from sea level to 3,000 or 3,500 feet along the higher mountains. Here live most of the animals and plants of the region. The zone is divided into a humid northern and eastern and an arid southern division. The humid division is characterized by a persistent evergreen forest, and the arid division by deciduous foliage and by the interruption of the forest zone by open grassy savanas which become parched in appearance in the dry season.

2. *Upper Tropical or Subtropical Zone.* This zone embraces the crests and slopes of mountains from 3,000 to 8,000 feet in altitude. Almost the entire area is densely forested with palms, and the zone as a whole is humid but with marked differences of precipitation due to varying slope exposure.

3. *Temperate Zone.* This zone extends from 8,000 feet upward, with varying temperatures near the summit. The Volcan de Chiriqui, with summit elevation of 11,500 feet above sea level, is the only place in Panama where the zone is developed. The trees are smaller in size with short trunks and widely spreading branches. The zone seems to have the characteristics of higher zones in the mountains of Costa Rica. It contains representatives of the boreal life zones of North America.

Notes on the Climate of Panama. Were it not for the heavy rainfall of the Canal Zone the great canal locks could not be operated through the four-month dry season. But sometimes there is too much rain water. What would one of our towns look like if in the course of a 7.60-inch rainfall in 24 hours, about 2.50 inches fell in 3 minutes? This seems to have been the experience of Porto Bello, on the Atlantic Coast of Panama, on November 29, 1911. From the automatic record of this cloud-burst it appears that 3.22 inches fell from 12:45 to 1:50 A. M., 0.13 inch from 1:50 to 2:07, 2.47 inches from 2:07 to 2:10, and 0.49 inch from 2:10 to 2:45. Although a rainfall of 2.47 inches in 3 minutes exceeds by 100 per cent the rate of fall during the rain of July 7, 1889, when 8.07 inches fell in 20 minutes at Curtea de Arges, Rumania, heretofore considered the world's record, it seems best to accept this as an actual occurrence (H. G. Cornthwaite: Panama Rainfall, *Monthly Weather Rev.*, May, 1919, pp. 298-302; B. C. Kadel: The Most Intense Rainfall on Record, *ibid.*, May, 1920, pp. 274–276).

The rainfall at Porto Bello in November and December together averages 48 inches, an amount greater than the annual fall over three-quarters of the United States; and, in addition to this, Porto Bello is washed by 10 feet more of rain during the remainder of the year. More than half—most of the Atlantic watershed—of the Canal Zone has an average annual rainfall exceeding 100 inches. Is it any wonder that there are land slides, that a dense tropical jungle flourishes there, that swamps are extensive, and that mosquitoes and the yellow fever and malaria they transmit led to the failure of early canal attempts?

Now that the malignant indirect effects of the excessive rainfall are under control, how can man get along with the tropical heat, the enervating humidity, and the deadening equability? The answer is: daytime cloudiness, a sunlight-absorbing blanket of moist air, and a breeze. The average daytime cloudiness in the dry season, December to March, is about 50 per cent, and in the rainy season, April to November, about 75 per cent. In the dry season the interior and the Pacific side have more cloudiness than the Atlantic side, where the wind comes off the sea clear. In the rainy season the nights are cloudy, while in the dry season the daytime cumulus clouds disappear in the evening. Although Panama is in one of the cloudy belts of the earth, there is, on the average, only one day a month that the sun does not shine; and the longest consecutive period without sunshine of which there is authentic record, was 4 days (H. G. Cornthwaite: Sunshine and Cloudiness in the Canal Zone, *Monthly Weather Rev.* May, 1920, pp. 276–277; Humidity and Hot Weather, *ibid.*, pp. 277–278). Fortunate for man is it, that every day the earth puts up its convectional cloud sunshade.

But this is protection, not relief. A steamy summer's day in the United States shows us occasionally what the weather feels like in Panama during the rainy season. The computed average maximum sensible temperature for July (wet bulb) is 79° F. at Balboa Heights (Pacific side) and 78.5° F. at Cristobal (Atlantic side). The average maximum air temperatures, however, are 87° and 84°, respectively—like St. Louis and Philadelphia in July. A wet-bulb temperature three degrees lower than in the rainy season, and twice as much wind, make the weather of the dry season less oppressive. In spite of the humidity there have been but two deaths from sunstroke and but 21 cases of heat exhaustion in a population of 120,000 in 13 years! The eastern United States has no such record; but perhaps if we worked with no greater intensity than do the people of Panama, our heat-stroke record would be better.

We face a perplexing situation: hot, arid regions with brilliant sunshine—no sunstrokes; a hot, extremely humid region—few sunstrokes; moderately humid, warm regions —occasional sunstrokes; and, finally, we remember that most tropical lowlands with climates apparently like that of Panama are dangerous for the white man who does manual labor or exposes his head to the sun. In Liberia the coastal lowlands have temperature, humidity, cloudiness, and rainfall characteristics much like those of the Atlantic coast of Panama, but a white man can get a "touch of the sun" with only a few minutes exposure, and manual labor, such as is performed constantly by white men in Panama, is here deadly (see Emory Ross: The Climate of Liberia, *Geogr. Rev.*, Vol. 9, 1919, pp. 387–402). Evidently the sunlight is more intense there, and probably also in moderately humid warm regions, than in Panama. Either intense sunlight or high wet-bulb temperatures are livable for the white man, but not the two in combination. From the white man's point of view no description of a tropical climate can be complete without information as to the intensity of sunlight.

CHARLES F. BROOKS

EUROPE

A New Ethnographic Map of Rumania. A first-class contribution to human geography has been made by Professor Emmanuel de Martonne in an article on the ethnography of Rumania (Essai de carte ethnographique des pays roumains, *Annales de Géographie*, March 15, 1920, pp. 81–98). It is the result of extended field work in Rumania, principally in the northern and central Carpathians, and of an examination of all of the available sources of data. His conclusions are particularly important at this time because of their relation to the new boundaries of Rumania as established on the west by the Hungarian treaty and on the south by the Bulgarian treaty. On her eastern frontier Rumania still occupies Bessarabia, but her title to the region has not been confirmed by the Great Powers, who are waiting for the Russian situation to clear up before expressing an opinion as to the merits of Rumania's claims in this direction.

One of the most striking of the author's conclusions is that the boundary on the west is perhaps the most difficult of all because of the intimate mixture of Rumanians and Magyars, as well as other nationalities, precisely in the border zone where a boundary line must be placed. The matter is further complicated by the location of the principal towns, such as Temesvar, Arad, Nagy Varad, and Szatmar-Nemeti, which lie right in the narrow transition zone, and for which there was naturally waged a violent contest, the more so since the towns are connected by a railroad that is the chief line of communication for a large region.

De Martonne finds that the Rumanians are most nearly homogeneous in the regions of former Roman colonization, that is, in western Wallachia, the eastern Banat, and western Transylvania. They are most mixed in those portions of the country long included in neighboring states of different nationality, either during many centuries as in Transylvania or during the course of the last century only as in Bukovina and Bessarabia. The purest Rumanian populations are found in the Carpathian valleys.

Rumanians appear for a long time to have preferred the forested regions of considerable relief, rich in water and pasturage. Movement to the plains and the absorption of foreign

elements that existed there were later developments. In pushing outward the population has not stopped at natural boundaries, and this invites comment by the author to the effect that a map constructed on a geographical principle would show relations between the history and the physical geography that are hidden in maps constructed on a purely statistical principle.

The special value of de Martonne's map lies not alone in the care exercised in its construction but also in his choice of three shades of density which permit one to see at a glance not only the nationality involved at a given point but its relative density, which means, in general, its relative importance. The larger cities are represented by divided circles that show the nationality percentages.

AFRICA

The Development of the Coastal Belt of South Africa. On the eastern and southern coasts of South Africa there is a belt averaging 100 miles wide, varying in elevation from sea level to 6,000 feet, with a great variety of climate and of vegetable products. Fruits of almost every sort grow prolifically. Stock raising is carried on, farm products of wide variety can be produced. In any study of the possibilities of future white settlement in South Africa this coastal belt has unusual importance, since it is capable of much greater agricultural development in contrast to the high but relatively temporary development about Kimberley (diamonds) and Johannesburg (gold). There has now been published a paper of considerable interest to geographers in that the economic geography of the region is set forth systematically (T. Caink: The Possibilities and Development of the Coastal Belt of South Africa, *South African Journ. of Sci.*, Vol. 16, 1919, pp. 211–225).

The author has made a detailed study of the rainfall distributions and the run-off; and he finds that an important part of the coastal belt enjoys a rainfall above 40 inches, and some of it as high as 70 inches. Detailed tables are given. The belt of more intense rainfall is from 10 to 30 or 40 miles wide and roughly 1,000 miles in length. To be conservative the author takes an average width of 15 miles, giving a total catchment area for the belt of 15,000 square miles. From a study of the general resources of the region he would propose, not white settlement in the region of heavier rainfall, but the absence of settlement and the development of a forest cover. He would then introduce the principles of irrigation, storing the water for the dry season and encouraging particularly the practice of building small irrigation works for tributary supplies. To carry out the plan he advocates the purchase of the rain belt by the government, the development of a forest cover, the equalization of run-off, the building of railways, and the development of water power. With an abundance of cheap labor and a favorable combination of sunshine and water supply, he would turn the region into one of intensive agriculture and industrial development. The oil, nuts, rubber, cocoa, and cotton that now go by steamer to Europe he would bring from tropical Africa to South African ports to be manufactured, in the coastal belt, for export. He arrives at the conclusion that the whole coastal belt of 85,000 square miles could eventually become a great industrial center like England with a population of 50,000,000, or 600 to the square mile.

AUSTRALASIA AND OCEANIA

The Tapestry Forests of Hawaii. Associated with the more humid aspects of the highly dissected Hawaiian topography is a peculiar form of the rain forest to which Vaughan MacCaughey gives the name "tapestry forest" (Hawaii's Tapestry Forests, *Botanical Gazette*, August, 1920, pp. 137–147).

The tapestry forest is developed on the precipitous slopes that to the eye appear almost vertical. Actually the range of these slopes is between 40° and 80°, averaging 50° – 60°. In altitude this forest ranges between 800 and 4,500 feet. It presents a primitive appearance, steepness, wetness, and general inaccessibility having prevented the devasta-

tions wrought by man and animals on the lower slopes. The struggle against wind and gravity leaves a marked impress on the trees. They are dwarfed and gnarled and distinguished by a remarkable system of anchoring and bracing roots. Where erosion has removed the scant soil cover the roots are exposed as a sort of natural ladder utilized by natives and woodsmen in climbing slopes that otherwise would not infrequently prove impossibly steep. There is an abundant shrubby undergrowth. At the lower elevations lianas form almost impenetrable jungles. Above 2,000 feet, where fog and mist prevail throughout the greater part of the year, lianas give place to damp soggy moss formations. The foliage in general tends to small, glossy leaves which with the general similarity in the shape of the tree crown contributes towards uniformity in appearance. Individual trees are distinguished by differences in the green tints. Looked at from below this heightens the effect of drapery expressed in the appropriate term tapestry forest.

WORLD AND LARGER PARTS

Who Owns the Earth? Under this title J. E. Spurr analyzes the mineral wealth of the world and the relative positions of the United States, England, and Japan (*Engineering and Mining Journ.*, Vol. 109, 1920, pp. 388–391). The chief value of the paper lies not in its political discussions but in its two accompanying diagrams showing, the one, the comparative commercial (financial) control and the other, the territorial (political) control of eighteen minerals by principal producing countries. Some of the most important conclusions are as follows. The United States produced, in 1917, 71 per cent of the world's petroleum. It leads in the production of iron and steel, copper and lead, sulphur, phosphate rock, vanadium, aluminum, and several other mineral products. The British Empire leads in tin—a key industry—and in nickel, gold, graphite, and tungsten; it is fast gaining on the United States in petroleum production and is second to us in coal. Russia formerly (1913) led in manganese production, but the effect of present conditions is to give Britain the lead. Territorially Spain is foremost as a producer of mercury but financially the industry is dominated by Britain. Of the few minerals remaining outside the control of the United States and the British Empire, the chief are the nitrates of Chile and the potash reserves now divided almost equally between France and Germany. The paper contains opinions by the author as to the effect of these distributions upon the political policies of the leading industrial nations.

GEOGRAPHICAL REVIEWS

Syria and the Syrian Question

Augustin Bernard. **La Syrie et les Syriens.** *Ann. de Géogr.*, No. 151, Vol. 28, 1919, pp. 33–51.

Arthur Ruppin. **Syria: An Economic Survey.** Transl. and abridged by Nellie Straus. 92 and iv pp.; bibliogr. The Provisional Zionist Committee, New York, 1918. 75 cents. 9 x 6 inches.

The author of "La Syrie et les Syriens" first calls attention to the historic frontiers of the country, which included the region from Antioch to the Sinai peninsula and from the Mediterranean to the desert east of the coastal mountains. Thus defined Syria is a strip of country 600 miles long and less than 100 miles wide, in which the sea plays somewhat the same rôle as the Nile in Egypt. He would not accept the old boundary of the Orontes at the north, considering the Taurus and the Anti-Taurus as the natural frontier on this side—the more as the Gulf of Alexandretta is a coastal feature of vital importance, a natural outlet for large parts of Syria, Mesopotamia, Armenia, and Anatolia; and if held by any one of these with no outside supervision, the result would be harmful to the other interested parties.

The author reviews the agricultural possibilities, particularly the production of cotton on the plains of Adana where 800,000 hectares of cotton land may be eventually developed. The railroads reflect the vagaries of international politics. They are local lines that now need integration. Only their connection with those of Anatolia, Mesopotamia, and Egypt will bring Syria into one of the main currents of world trade. In Phoenician times Syria was a great center of the Near Eastern world; and this position it kept until the Turk came and the route to India was opened. The opening of the Suez route was a final blow to the commercial power of Syria. Far-famed Damascus kept only its commerce with the desert Bedouins.

The former population of Syria is alleged to have been 20,000,000 to 30,000,000; its present population is estimated at 3,500,000 to 4,000,000, or 26 to the square mile. More than a quarter of the population lives in the 28 principal cities. The rural population is very unevenly distributed. The greatest regional density is 230 to the square mile, in the Lebanon. The security of the plains, as well as their greater fertility, is responsible for the concentration of population there. The limits of nomadism, like the isohyets, run in a southwest-northeast direction. A half million Syrians live outside Syria—in the United States, Mexico, Argentina, Brazil, Australia, western Africa, and Japan. Immigration is almost negligible, and the increase of population is slow, owing to massacres, a high rate of infant mortality, and bad government. A few Berbers have come in, a few Kurds, a few German colonists, and the Zionist colonists of Palestine.

There is a useful discussion of the mixture of races and religions. There are 29 officially recognized religious groups, which fall into three main classes—Mohammedans, Christians, Jews. Of the total population nearly 2,500,000 are Mohammedans. There are 950,000 Christians, or one-fourth of the total. Of these the largest group is composed of 380,000 Maronites; then come the Greek Orthodox with 240,000. Jews numbered only 30,000 seventy years ago and now number 100,000 in Palestine or 125,000 in all Syria, including Palestine. The author argues against Jewish control in a Zionist state. He considers the religious question less formidable than many others, seeing that religious differences were formerly made the instrument of politics and that left alone, Armenians and Kurds, Maronites and Druses live together peaceably. Effective policing would reduce the raids of the nomads. Even so its mixture of races and religions will make Syria difficult to govern. It is believed that in time there will be three foci of population: a Mohammedan focus at Aleppo and Hama; a central Christian focus at Beirut; a southern Jewish center at Haifa and Jerusalem. There would also be a nucleus of Mohammedans at Damascus, of Druses in the

Haurân, and of Armenians about the Gulf of Alexandretta. Left to rule themselves, there would be bloodshed; an outside force is necessary. French commercial and political interests and objects are reviewed briefly.

From the list of references given and from internal evidence, Ruppin's survey of the economic condition of Syria seems to be the result of careful work. It is really a source book of the commercial geography and economics of Syria. Its trade statistics are logically arranged. The resources of every kind are described in illuminating terms whether the author deals with forestry, or agriculture, or irrigation. Of special interest is a list (pp. 29–31) of the Jewish agricultural settlements of Palestine in 1914, giving location, area, population, principal products and date of foundation. The accompanying notes on these colonies give a close view of their history and present economic status.

Historical Claims and Territorial Disputes in Central Europe

E. Schwab. **Territoriale Abrundungsbestrebungen in Mitteleuropa: Ein Beitrag zur historisch-politischen Geographie der ehemaligen österr.-ung. Monarchie.** Map. *Kartogr. und Schulgeogr. Zeitschr.*, Vol. 8, 1919, Nos. 5 and 6, pp. 76–79. Vienna.

The greater part of this paper deals with the historical successions and territorial changes that have taken place in the six geographical systems, so-called, that lie in the Danube basin. Each system is now expressed politically in a national home (owing to the break-up of the Austro-Hungarian realm), and each has in the course of history brought forth an empire of wide influence and extent. The fullest extent of each, at some time in its history, has been reached at the expense of its neighbors. Thus have arisen conflicting historical claims that have led to present-day territorial disputes of grave consequence for the peace of Europe. By combining the historical with the ethnic principle the author has derived a map, printed in color, which shows the overlapping claims of Central Europe and part of the Balkans. Nothing else could show more clearly at once the great complexity of the territorial disputes of the region and the custom of European peoples of thinking historically in contrast to the simpler processes related to boundary settlements that operate in America and other relatively new lands.

An Ethno-geographical Analysis of Indian Cultures in the Gran Chaco

Erland Nordenskiöld. **An Ethno-Geographical Analysis of the Material Culture of Two Indian Tribes in the Gran Chaco.** xi and 295 pp; maps, diagrs., ills., bibliogr. (Comparative Ethnographical Studies, Vol. 1.) Göteborg, 1918. 9½x6½ inches.

Idem. **The Changes in the Material Culture of Two Indian Tribes under the Influence of New Surroundings.** xvi and 245 pp.; maps, diagrs., ills., bibliogr. (Comparative Ethnographical Studies, Vol. 2.) Göteborg, 1920. 9½ x 6½ inches.

In these two volumes Dr. Nordenskiöld gives the results of his studies of Indian tribes of southern Bolivia and northern Argentina initiated years ago and continued in several later expeditions. Dr. Nordenskiöld's method is to assemble the information supplied by the literature; to supplement this with information on the civilization of the Indians from missionaries and travelers; and, in the light of the data thus acquired and of his own field studies, to analyze the material culture of the Indians. The two volumes together contain 60 maps, showing the distribution of culture elements among the Choroti, Ashluslay, Chiriguano, and Chané. These Indian tribes occupy the region from Santa Cruz de la Sierra southward nearly to the Rio Bermejo—the transition country between the Andean realm and the plains of Gran Chaco, a region in part densely forested, in part poorly wooded. The location of the settlements is governed by the water supply. While some of the streams are through-flowing the greater number of them disappear at the inner edge of the piedmont plain. Big game is scarce. The Chiriguano and Chané Indians live almost wholly by agriculture; maize can be produced easily. In years of little or

no rain the crops are a failure. The Choroti and Ashluslay are restricted to the neighborhood of streams or deep wells in the dry season. The wet season is from December to April or May. On account of the contrast in the Choroti and Ashluslay country between the wet and the dry season and the abundance of wild fruit agriculture is very little developed. Fortunately the trees of the region are of a variety which furnish an exceptional quantity of food.

The first volume deals with the distribution of elements of material culture—pipes, carrying nets, wooden spoons, earthen ovens, drums, etc., among the Choroti and Ashluslay. In the concluding chapters the author sets forth in exhaustive tables a list of cultural elements borrowed by these Indians from: (*a*) the whites since the discovery; (*b*) the culture of high mountain and plateau country to the west; (*c*) the culture of northern South America. After eliminating these elements he finds that a considerable number of cultural elements of unknown origin remain over and represent a remote period. Some are restricted to the Gran Chaco, and these appear to have close connections with the cultural elements of the Patagonian Indians.

From the maps in the second volume showing the distribution of dwellings, platform beds, hammocks, trumpets, panpipes, masks, etc., Dr. Nordenskiöld concludes that the Chiriguano and Chané tribes came from the north and have very close cultural associations with the tribes of the Amazon realm. He thinks that it was in order to facilitate intercourse with the culture of the mountain zone (that is the culture of the Bronze Age) that the Chané wandered southward along the Andes to the more open country of the Gran Chaco where communication was easier, though he does not overlook the possibility that they may have been forced southward by other tribes. The Chiriguano established themselves in their present localities about the beginning of the sixteenth century and quickly picked up the Bronze Age culture from the original inhabitants of the Gran Chaco, whom they conquered. They adopted the culture of the original inhabitants, but the original inhabitants adopted the language of the conquerors. The Chiriguano and Chané thus borrowed heavily from tribes having cultural elements of a more advanced character but borrowed scarcely at all from tribes like the Tobas and Matacos of more primitive culture. A few of their cultural elements have come in from northern and eastern South America. One such is the india-rubber ball game; others are the hammock and the seat, possibly known to them before they migrated to the Gran Chaco. An interesting feature is the fact that they have kept from the time of their migration to the Gran Chaco some things that are of minor importance in their present habitat, for example, fishing tackle.

The author departs from Wissler's classification of the food areas of South America (see map, Fig. 1, p. 264). Wissler recognizes three: (1) area of intensive agriculture, (2) manioc area, (3) guanaco area. The proposed division of Nordenskiöld is: (1) area of intensive agriculture, (2) area of manioc and fishing, (3) area of wild seeds and fishing—El Gran Chaco, (4) guanaco area.

Both volumes close with a very extensive bibliography, and the second volume also includes six bibliographical maps of an extremely useful kind. From them one can pick out for a given region the chief bibliographical sources. The dates of five of the maps are as follows: 1498–1600, 1600–1700, 1700–1800, 1800–1900, 1900–1920. The sixth map displays the archeological literature.

The French-Indian Métis in the Development of the United States

L. S. Houghton. **Our Debt to the Red Man: The French-Indians in the Development of the United States.** With an Introduction by Francis E. Leupp. xi and 210 pp.; ills. The Stratford Co., Boston, 1918. 8 x 5¼ inches.

The purpose of this little book is to prove that the "Indian has done more for us than we realize, or at this distance of time shall perhaps ever be able wholly to ascertain." It is not geographical except as it bears on the question of the part played by environment

versus heredity. Its general method is very simple. Some of the good traits of the aboriginal Indians and their successors are pointed out; then follows a discussion of the Indian half-breeds with many references to individuals and to their achievements. The result is not, perhaps, as imposing as the author believes, but it shows that many persons with Indian blood have done excellent work and have been good citizens while a few have distinguished themselves.

In spite of this, the book is one of the strongest indictments of the Indian ever written. It repeatedly emphasizes the fact that the individual achievements of the race have been the work, not of pure Indians, but of French *métis* or mixed bloods. This is in accord with the laws of eugenics, provided it be true that the average Indian is mentally less alert than the average white man. Crosses of the Indians with the English, as the author points out, have usually resulted in poor, shiftless offspring; crosses with the Scotch and Irish have been somewhat better, while those with the French have produced many able people. The explanation is not the incompatibility of the Indians and the English, as the author assumes, but simply a result of social conditions. Marriage with the Indians was regarded with high disfavor by the English, and such unions as came about were usually between Englishmen of low character and Indian women of a lower grade. Among the Scotch and Irish, marriages with the Indians were not so much frowned upon while by the French they were regarded with favor. Consequently many Frenchmen with the best sort of inheritance married daughters of Indian chiefs. Naturally the descendants of high-grade ancestors on both sides have proved competent and useful, while the descendants of low-grade Englishmen and low-grade Indian women have proved incompetent.

ELLSWORTH HUNTINGTON

ALBERTA AND BRITISH COLUMBIA: INTERPROVINCIAL BOUNDARY REPORT

Report of the Commission Appointed to Delimit the Boundary Between the Provinces of Alberta and British Columbia: Part I, from 1913 to 1916. 2 vols.: text and atlas. Text: xi and 191 and [5] pp.; diagrs., ills., index. 10 x 7 inches. Atlas: 27 maps. 18 x 15½ inches. Office of the Surveyor General, Dept. of the Interior, Ottawa, 1917.

This report of the Interprovincial Boundary Commission describes the method of survey and especially the technique of photographic survey employed, the monumentation of the boundary, and the present condition of roads and trails within the scope of the accompanying maps. There is now needed an integration of the cartographic data with data already available from similar work by the Canadian forest service and the geological survey.

Future explorers and students will find the Commission's comments on trails particularly useful. It appears that "any trail, the existence of which has at any time been authenticated by surveyors, packers, prospectors, or other travelers and which has once been marked on the maps of a district, is reproduced on each succeeding issue of such map without further knowledge of the present-day condition of such trail." The present state of the trail is of course a more important matter than the mere location of it. Fallen timber and later growth may have completely blocked a given trail since it was opened. The matter is a special feature here because the coming of the railways and the resulting diversion of freight routes has led to the opening of new roads and trails and the abandonment of many of the old ones.

The report is illustrated by many clear and useful photographs; and it is accompanied by an atlas of twenty-seven maps—twenty-six detailed maps, sixteen on a scale of 1:62,500, eight on a scale of 1:25,000, two on a scale of 1:35,000, and a general assembly sheet on a scale of 1:792,000. All of the maps represent a very high grade of technical skill in drafting and printing.

A New Cloud Atlas

Luigi Taffara. **Le nubi. Part I; Testo;** 67 pp.; diagrs., ills. **Part II, Atlante** [26 pls.] R. Ufficio Centrale di Meteorol. e Geodinamica, Rome, 1917. 14 x 9½ inches.

That meteorology was far from dead in Italy during the war was clearly demonstrated by the activities of the forecasting service in connection with the military operations of the Italian armies, a matter which was several times referred to in this *Review*. Another indication of the excellent work which has been going on in Italy along meteorological lines is the publication of a new cloud atlas, prepared by Luigi Taffara. The appearance of such a work is sure to attract attention at any time, because of the widespread popular interest in clouds and in their significance as weather prognostics. This interest is, however, especially keen at present, when the development of war flying, and of commercial flying since the war, has directed attention to the study of the free air and especially to the mapping of the upper air currents. The forms and movements of clouds are clearly of the greatest value in determining the directions and velocities of the air currents above the earth's surface which are such critical factors in flight.

In "Le Nubi" the history of cloud classification, and the work of the International Meteorological Committee in connection with cloud classification and observation, are first considered. Then follows a somewhat detailed, and very practical, discussion of cloud photography, in which plates, screens, filters, methods of developing and printing, times of exposure, etc., are considered. Four photographs illustrate the effects of intensifying the original plates. The system of cloud nomenclature suggested by the author, while in its fundamentals following that recommended by the International Cloud Committee, is a far more elaborate one, embodying to a large extent the modifications suggested by Vincent in his "Atlas des nuages" (1907) but including also certain sub-types recommended by others, such, e. g., as the *cirrus filosus* and *cumulus pendulus* of Clayton; *cumulus simplex* and *cumulus compositus* of Weilbach; *cirrus uncinus* of Maze, and other special varieties of the principal forms. Of low clouds there are 25 types; of the intermediate there are 12, 11 of these being varieties of alto-cumulus; and of the upper clouds there are 19. That individual observers who are cloud specialists do need very detailed cloud classifications is obvious; but it is no less clear, as experience has abundantly proved, that for the general run of meteorological observers the world over, a simple and easily learned system of nomenclature, like that adopted by the International Meteorological Committee, is alone practicable. While in no way urging the limitation of the work of such specialists to the simple International scheme, it is the opinion of the present reviewer that nothing more elaborate than the standard international nomenclature is desirable, or possible, for general use. A discussion of methods of observing clouds occupies 30 pages of the text. Nephoscopes of various well-known types are described. An account is given of Marangoni's perspective nephoscope, by means of which the observer, taking observations of two points of the same cloud sheet, can determine the vertical component of cloud motion as well as the horizontal. A method of using a theodolite for making similar observations is described, and, at the end, the theodolite photogram nephoscope of Taffara is illustrated and described.

The "Atlas" includes 26 plates, each plate having two illustrations. Some of these are in colors, two being reproductions of water-color sketches, and one a reproduction of a pastel. The majority of the original photographs were taken by the author and are here seen for the first time. They illustrate every cloud form included by Taffara in his new system of nomenclature. Doubtless most of those who have the opportunity of examining this valuable Atlas will agree in picking out, as unique and most striking pictures, the five photographs of *cumulus simplex* which illustrate the special cloud type designated the *Cortessa del Vento* (Pls. 11, 12, 13). This is a peculiar form of cumulus, in the shape of a helicoidal spiral, which is described (text, p. 15) as often developing to the east of the central crater of Mt. Etna.

R. De C. Ward